DOCUMENT RESUME

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SPONS AGENCY Bureau of Occupational and Adult Education (DHEW/OE), Washington, D.C.

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IDENTIFIERS Military Curriculum Project

ABSTRACT

These instructor materials and student texts, study guides, and workbooks for a postsecondary-level course to train veterinary specialists are one of a number of military-developed curriculum packages selected for adaptation to vocational instruction and curriculum development in a civilian setting. It is the first half of a two-part course (see Note) intended to provide training in food inspection; laboratory procedures; subprofessional duties concerning veterinary sciences; sanitary surveillance of food processing, storage, and service facilities; control and epidemiology of zoonotic diseases; and veterinary aspects of disaster medicine. Dealing with microbiology, food handling, food laboratory, and meat and meat products, this section contains four blocks of instruction covering 122 hours of instruction: microbiology (3 lessons), medical aspects of food handling (2 lessons), food laboratory (3 lessons), and meat and meat products (5 lessons). Instructor materials include a course chart, Specialty Training Standard, for use in student evaluation, lesson plans, and a plan of instruction detailing unit content, lesson duration, objectives, and support material. Student materials include four student texts, study guide, two study guides/workbooks, and programmed text. Contents are objectives, text readings, review exercises, and laboratory experiments. Commercial texts, military manuals, and audiovisuals are suggested but not provided. (YLB)

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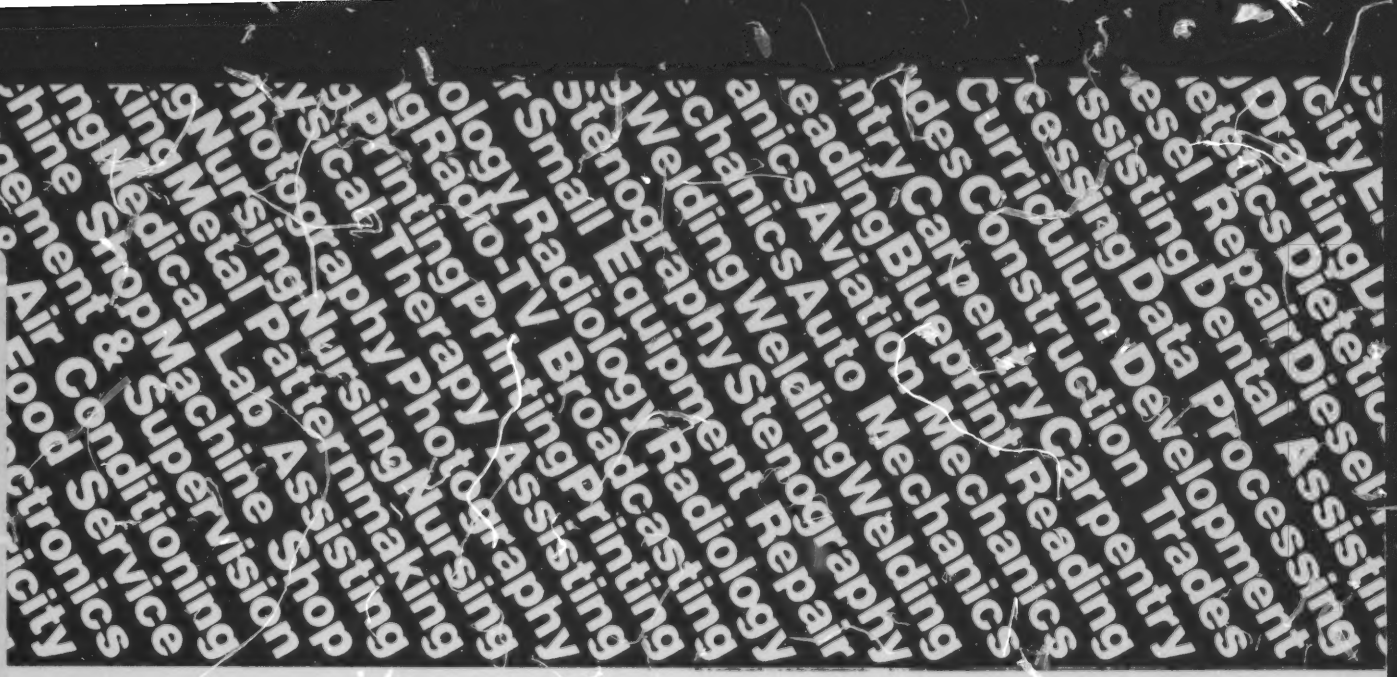

Military Curricula for Vocational & Technical Education

VETERINARY SPECIALIST

BLOCKS I-I thru VI

CE 024 377

THE NATIONAL CENTER
FOR RESEARCH IN VOCATIONAL EDUCATION
THE OHIO STATE UNIVERSITY

This military technical training course has been selected and adapted by The Center for Vocational Education for "Trial Implementation of a Model System to Provide Military Curriculum Materials for Use in Vocational and Technical Education," a project sponsored by the Bureau of Occupational and Adult Education, U.S. Department of Health, Education, and Welfare.

MILITARY CURRICULUM MATERIALS

The military-developed curriculum materials in this course package were selected by the National Center for Research in Vocational Education Military Curriculum Project for dissemination to the six regional Curriculum Coordination Centers and other instructional materials agencies. The purpose of disseminating these courses was to make curriculum materials developed by the military more accessible to vocational educators in the civilian setting.

The course materials were acquired, evaluated by project staff and practitioners in the field, and prepared for dissemination. Materials which were specific to the military were deleted, copyrighted materials were either omitted or approval for their use was obtained. These course packages contain curriculum resource materials which can be adapted to support vocational instruction and curriculum development.

The National Center Mission Statement

The National Center for Research in Vocational Education's mission is to increase the ability of diverse agencies, institutions, and organizations to solve educational problems relating to individual career planning, preparation, and progression. The National Center fulfills its mission by:

- Generating knowledge through research
- Developing educational programs and products
- Evaluating individual program needs and outcomes
- Installing educational programs and products
- Operating information systems and services
- Conducting leadership development and training programs

FOR FURTHER INFORMATION ABOUT
Military Curriculum Materials
WRITE OR CALL

Program Information Office
The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road, Columbus, Ohio 43210
Telephone: 614/486-3655 or Toll Free 800/848-4815 within the continental U.S. (except Ohio)

THE NATIONAL CENTER FOR RESEARCH IN VOCATIONAL EDUCATION
The Ohio State University · 1960 Kenny Road · Columbus, Ohio 43210
Tel (614) 486-3655
Cable: CTVOCEDOSU/Columbus, Ohio

Military Curriculum Materials for Vocational and Technical Education

Information and Field Services Division

The National Center for Research in Vocational Education

Military Curriculum Materials Dissemination Is . . .

an activity to increase the accessibility of military-developed curriculum materials to vocational and technical educators.

This project, funded by the U.S. Office of Education, includes the identification and acquisition of curriculum materials in print form from the Coast Guard, Air Force, Army, Marine Corps and Navy.

Access to military curriculum materials is provided through a "Joint Memorandum of Understanding" between the U.S. Office of Education and the Department of Defense.

The acquired materials are reviewed by staff and subject matter specialists, and courses deemed applicable to vocational and technical education are selected for dissemination.

The National Center for Research in Vocational Education is the U.S. Office of Education's designated representative to acquire the materials and conduct the project activities.

Project Staff:

Wesley E. Budke, Ph.D., Director
National Center Clearinghouse

Shirley A. Chase, Ph.D.
Project Director

What Materials Are Available?

One hundred twenty courses on microfiche (thirteen in paper form) and descriptions of each have been provided to the vocational Curriculum Coordination Centers and other instructional materials agencies for dissemination.

Course materials include programmed instruction, curriculum outlines, instructor guides, student workbooks and technical manuals.

The 120 courses represent the following sixteen vocational subject areas:

- Agriculture
- Aviation
- Building & Construction Trades
- Clerical Occupations
- Communications
- Drafting
- Electronics
- Engine Mechanics
- Food Service
- Health
- Heating & Air Conditioning
- Machine Shop
- Management & Supervision
- Meteorology & Navigation
- Photography
- Public Service

The number of courses and the subject areas represented will expand as additional materials with application to vocational and technical education are identified and selected for dissemination.

How Can These Materials Be Obtained?

Contact the Curriculum Coordination Center in your region for information on obtaining materials (e.g., availability and cost). They will respond to your request directly or refer you to an instructional materials agency closer to you.

CURRICULUM COORDINATION CENTERS

EAST CENTRAL
Rebecca S. Douglass
Director
100 North First Street
Springfield, IL 62777
217/782-0759

NORTHWEST
William Daniels
Director
Building 17
Airdustrial Park
Olympia, WA 98504
206/753-0879

MIDWEST
Robert Patton
Director
1515 West Sixth Ave.
Stillwater, OK 74704
405/377-2000

SOUTHEAST
James F. Shill, Ph.D.
Director
Mississippi State University
Drawer DX
Mississippi State, MS 39762
601/325-2510

NORTHEAST
Joseph F. Kelly, Ph.D.
Director
225 West State Street
Trenton, NJ 08625
609/292-6562

WESTERN
Lawrence F. H. Zane, Ph.D.
Director
1776 University Ave.
Honolulu, HI 96822
808/948-7834

VETERINARY SPECIALIST, BLOCKS III-VI

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Veterinary Microbiology - Student Text	Page 24
Veterinary Microbiology - Study Guide and Workbook	Page 44
Block IV - Medical Aspects of Food Handling	
Medical Aspects of Food Handling - Student Text	Page 69
Medical Aspects of Food Handling - Workbook	Page 112
Block V - Food Laboratory	
Food Laboratory - Student Text	Page 127
Block VI - Meat and Meat Products	
Meat Inspection - Student Text	Page 157
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VETERINARY SPECIALIST, BLOCKS III–VI

Classroom Course 1-3

Developed by:
United States Air Force

Development and Review Dates:
July 11, 1975

Occupational Area:
Agriculture

Target Audiences:
Grades 13-adult

Print Pages:
340

Cost:
$7.00

Availability:
Military Curriculum Project, The Center for Vocational Education, 1960 Kenny Rd., Columbus, OH 43210

Contents:	Type of Materials: Lesson Plans:	Programmed Text:	Student Workbook: No. of pages	Handouts:	Text Materials:	Audio-Visuals:	Instructional Design: Performance Objectives:	Tests:	Review Exercises:	Additional Materials Required:	Type of Instruction: Group Instruction:	Individualized:
Block III – *Microbiology*	•		25		•	★	•	★	•	★	•	
Block IV – *Medical Aspects of Food Handling*	•		15	★	•	★	•	★	•	★	•	
Block V – *Food Laboratory*	•	•		★	•	★	•	★	•	★	•	
Block VI – *Meat and Meat Products*	•			•	•	★	•	★	•	★	•	

★ Materials are recommended but not provided.

THE CENTER FOR VOCATIONAL EDUCATION

Expires July 1, 1978

Course Description

This is the first of a two-part course to train veterinary specialists. The course includes training in food inspection, laboratory procedures; subprofessional duties concerning veterinary sciences; sanitary surveillance of food processing, storage, and service facilities; control and epidemiology of zoonotic diseases; and veterinary aspects of diaster medicine. This section contains four blocks of instruction on microbiology, food handling, the food laboratory, and meat and meat products. The second section, **Veterinary Specialist, Blocks VII–XI**, contains information on poultry and egg inspection, dairy products, miscellaneous foods, food technology, and animal services. Two blocks of instruction have been deleted because they dealt exclusively with military forms and procedures.

Block III – *Microbiology* contains three lessons covering 24 hours of instruction. The lesson topics and respective hours follow:

Principles of Microbiology (18 hours)
Microbiology Laboratory (2 hours)
The Microscope (4 hours)

Block IV – *Medical Aspects of Food Handling* contains two lessons covering 32 hours of instruction. A third lesson on the organization and objectives of the Aerospace Medicine Program was deleted.

Medical Aspects of Insect and Rodent Control, Water Purification, Sewage and Waste Disposal (5 hours)
Medical Evaluation of Food Service Facilities (27 hours)

Block V – *Food Laboratory* has three lessons covering 22 hours of instruction.

Laboratory Analyses of Foods (9 hours)
Laboratory Analyses of Food Contact Surfaces and Personal Hygiene of Food Service Personnel (10 hours)
Collection and Submission of Laboratory Samples (3 hours)

Block VI – ***Meat and Meat Products*** contains five lessons covering 44 hours of instruction.

Meat Inspection Agencies (2 hours)
Anatomy and Physiology of Meat Animals (5 hours)
Slaughtering, Processing, and Grading of Meat Animals (17 hours)
Processing and Inspection of Veal, Calf, Lamb, Pork, and Cured and Smoked Meats (11 hours)
Inspection of Meat and Meat Products (9 hours)

This course contains both teacher and student materials. Printed instructor materials include a course chart; a Specialty Training Standard for use in student evaluation; lesson plans; and a plan of instruction detailing the unit content, duration of the lessons, objectives, and support materials needed. Student materials include four student texts; one study guide; two study guide/workbooks; one handout; and one programmed text. These materials include objectives, text readings, review exercises, and lab experiments.

Several military manuals and commercially produced texts are recommended as references but are not provided. The materials provided have a definite military orientation and contain numerous forms or procedures which might or might not be of use in the civilian sector. These materials can be used with a large group or adapted for individualized study in veterinary or foods processing courses.

Audiovisuals suggested for use with the entire course, but not provided, are 43 films, 9 transparency sets, 10 slide sets, and 2 sound/slide programs.

SIW/Britz 3 NOV 1975	
COURSE NUMBER 3ABR90830	COURSE TITLE Veterinary Specialist
BLOCK NUMBER VI	BLOCK TITLE Meat and Meat Products
LESSON TITLE Inspection of Meat and Meat Products	

LESSON DURATION		
CLASSROOM /Laboratory	Complementary	TOTAL
9 hrs	4 hrs	13 hrs

POI REFERENCE		
PAGE NUMBER 24	PAGE DATE 11 Jul 75	PARAGRAPH 6a, 6b

STS/CTS REFERENCE	
NUMBER TS908X0	DATE 25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	3 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Hobart Fat Test Kit Beam scales Assorted meat samples	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

a. Given appropriate inspection documents, standards, narrative descriptions of practical exercises, and samples of beef roasts and steaks, perform a verification inspection and complete all required inspection reports. Satisfactory achievement consists of attaining a score of not less than 70% when scored according to an established checklist 3ABR90830-VI-6a.

b. Given applicable inspection documents and standards, samples of various meat items and a narrative description of a practical exercise, conduct a COLEQUAP evaluation and complete all required reports. Satisfactory achievement consists of attaining a score of not less than 70% when scored according to an established checklist 3ABR90830-VI-6b.

(Teaching steps listed in Part II)

FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
USDV/Britz 3 NOV 1975	
COURSE NUMBER: 3ABR90830	COURSE TITLE: Veterinary Specialist
BLOCK NUMBER: VI	BLOCK TITLE: Meat and Meat Products

LESSON TITLE: Processing and Inspection of Veal, Calf, Lamb, Pork and Cured and Smoked Meats

LESSON DURATION		
CLASSROOM / Laboratory: 11 hrs	Complementary: 4 hrs	TOTAL: 15 hrs

POI REFERENCE		
PAGE NUMBER: 23	PAGE DATE: 11 Jul 75	PARAGRAPH: 5a

STS/CTS REFERENCE	
NUMBER: STS908X0	DATE: 25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	3 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Swine skeleton	None	None	ST 3ABR90830-VI-1 Transparencies, Meat Series

CRITERION OBJECTIVES AND TEACHING STEPS

5a. Identify the steps of processing and the procedures for inspecting veal, calf, lamb, pork and cured and smoked meats.

(Teaching steps listed in Part II)

AFC FORM 770

PV/Aritz Butz 3 NOV 1975	
COURSE NUMBER AABR90830	COURSE TITLE Veterinary Specialist
LOCK NUMBER	BLOCK TITLE Meat and Meat Products

N TITLE
Slaughtering, Processing and Grading of Meat Animals

LESSON DURATION		
CLASSROOM/Laboratory 17 hrs	Complementary 6 hrs	TOTAL 23 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
22	11 Jul 75	3a

STS/CTS REFERENCE

NUMBER	DATE
STS908X0	25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Butz Jr	3 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Laboratory coats Safety helmets	None	None	ST 3ABR90830-VI-1 16mm Film - PLC 13-137, Mark of Wholesome Meat (17 min) Transparencies, Meat Series

CRITERION OBJECTIVES AND TEACHING STEPS

a. Identify the appropriate standards for slaughtering, processing and grading of meat animals and sanitary standards of meat processing facilities.

(Teaching steps listed in Part II)

FORM AUG 72 770

Graphic Aids and Unclassified Material Cont'd.

ST 3ABR90830-VI-1
Transparencies, Meat Series
Military Specification - MIL-B-43813, Beef Roasts and Steaks, Boneless, Frozen
Federal Specification - PP-B-81, Bacon, Slab or Sliced, Chilled or Frozen
MIL-STD 105D, Sampling Procedures and Tables for Inspection by Attributes
Air Force Services Office Consumer Level Quality Audit Program Handbook
HO 3ABR90830-VI-6, Inspection of Meats

APPROVAL OFFICE AND DATE	INSTRUCTOR
14 NOV DV/Britz	
COURSE NUMBER 3AUR90830	COURSE TITLE Veterinary Specialist
BLOCK NUMBER	BLOCK TITLE Meat and Meat Products

LESSON TITLE
Anatomy and Physiology of Meat Animals

LESSON DURATION		
CLASSROOM /Laboratory 5 hrs	~~xxxxxxxx~~Complementary 3 hrs	TOTAL 8 hrs

POI REFERENCE		
PAGE NUMBER 21	PAGE DATE 11 Jul 75	PARAGRAPH 2a

STS/CTS REFERENCE	
NUMBER STS909X0	DATE 25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Swine skeleton (15)	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

2a. Identify meat product terminology and anatomical features and recognize various meat cuts.

(Teaching steps listed in Part II)

TC FORM AUG 72 770

Audio Aids and Unclassified Materials Cont'd.

SF 3AR900830-VI-1
Transparencies, Meat Series
16mm Film - Be A Better Angus Judge (25 min)
16mm Film - FLC 2-85, Beef Rings the Bell

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APPROVAL OFFICE AND DATE	INSTRUCTOR
14 NOV 1975	
COURSE NUMBER	COURSE TITLE
8A8300330	Veterinary Specialist
LESSON NUMBER	BLOCK TITLE
	Meat and Meat Products
LESSON TITLE	
Meat Inspection Agencies	

LESSON DURATION		
CLASSROOM /Laboratory	Complementary	TOTAL
2 hrs	1 hr	3 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
21	11 Jul 75	1a

STS/CTS REFERENCE	
NUMBER	DATE
STS00330	25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Beatty	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Identify the scope and responsibilities of meat inspection agencies involved in military procurement.

(Teaching steps listed in Part II)

1-3

ATC FORM AUG 72 770

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE 14 NOV 1975 MSDV/Britz	INSTRUCTOR
COURSE NUMBER 3ABR90830	COURSE TITLE Veterinary Specialist
BLOCK NUMBER V	BLOCK TITLE Food Laboratory
LESSON TITLE Collection and Submission of Laboratory Samples	

LESSON DURATION		
CLASSROOM /Laboratory 3 hrs	~~LABORATORY~~ Complementary None	TOTAL 3 hrs

POI REFERENCE		
PAGE NUMBER 19	PAGE DATE 11 Jul 75	PARAGRAPH 3a

STS/CTS REFERENCE	
NUMBER STS90830	DATE 25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E. Britz	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	ST 3ABR90830-V-1 DD Form 1222, Request for/and Results of Test

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Identify the correct procedures for collecting, preparing and submitting laboratory samples.

(Teaching steps listed in Part II)

nphic Aids and Unclassified Material Cont'd.

AR900830-VI-1, Meat Inspection
parencies, Meat Inspection Series
m Film - FLC 25-2, Your Meat Inspection Service (27 min)

LESSON PLAN (Part I, General)

[illegible] AND DATE) 4 NOV 1975	INSTRUCTOR
[illegible] Britz	
[illegible] NUMBER	COURSE TITLE
3ABR90830	Veterinary Specialist
[illegible] NUMBER	BLOCK TITLE
V	Food Laboratory

LESSON TITLE
Laboratory Analyses of Food Contact Surfaces and Personal Hygiene of Food Service Personnel

LESSON DURATION		
CLASSROOM/Laboratory	[illegible] Complementary	TOTAL
10 hrs	4 hrs	14 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
18	11 Jul 75	2a

STS/CTS REFERENCE	
NUMBER	DATE
STS908X0	25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Britz	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	ST 3ABR90830-V-1

CRITERION OBJECTIVES AND TEACHING STEPS

2a. Given applicable references, documents, standards and appropriate laboratory equipment and facilities, determine sanitary compliance and/or cleanliness of selected utensils, equipment, and food service personnel. Satisfactory achievement consists of attaining a score of not less than 70 percent when scored according to checklist 3ABR90830-V-2a.

(Teaching steps listed in Part II)

raphic Aids and Unclassified Material (Cont'd)

3ABR90830-V-1, Laboratory Services
3ABR90830-V-1a, Preparation of Solutions by Dilution
3ABR90830-V-1, Metric System

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE 14 NOV 1975	INSTRUCTOR
UNIT/CLASS NUMBER	COURSE TITLE
LESSON NUMBER	LESSON TITLE Veterinary Specialist
LESSON TITLE Laboratory Analyses of Foods	Food Laboratory

LESSON DURATION

CLASSROOM	LABORATORY	TOTAL
/Laboratory 9 hrs	xxxxxxx Complementary 2 hrs	11 hrs

POI REFERENCE

PAGE NUMBER	PAGE DATE	PARAGRAPH
18	11 Jul 73	1a

STS/CTS REFERENCE

NUMBER	DATE
STS908X0	25 March 1975

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Brantz Jr	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Quebec Colony Counters (1) Laboratory apron (1) Phydrion papers (1)	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Given applicable references, documents, standards, and appropriate laboratory equipment and facilities, determine microbiological and/or chemical acceptability and contract compliance of selected food items using proper laboratory procedures. Satisfactory achievement consists of attaining a score of not less than 70 percent when scored according to checklist 3AAR90830-V-1a.

(Teaching steps listed in Part II)

3-1

ATC FORM 770

raphic Aids and Unclassified Materials Cont'd.

- 3ABR00830-IV-1
- 3ABR00830-IV-3, Food Handler Training Program
- 163-8, Food Service Sanitation
- orm 977, Food Service Sanitation Checklist
- ransparencies, Food Service Sanitation Series
- ransparencies, Foodborne Illnesses Series
- 5mm Slides, Food Service Sanitation Series
- 5mm Slides, Foodborne Illnesses Series
- 6mm Film - TF 8103, An Outbreak of Salmonella Infection (14 min)
- 6mm Film - TF 5919, How Clean Is Clean? (20 min)
- 6mm Film - FLC 6574, Mr. Dish Machine Operator (12 min)
- 6mm Film - FLC 9-0237, Sanitation: Why All the Fuss? (11 min)
- 6mm Film - Dining Room Sanitation (11 min)

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
SDW/Britz 14 NOV 1975	
COURSE NUMBER: 3ABR90830	COURSE TITLE: Veterinary Specialist
BLOCK NUMBER: IV	BLOCK TITLE: Medical Aspects of Food Handling
LESSON TITLE: Medical Evaluation of Food Service Facilities	

LESSON DURATION		
CLASSROOM /Laboratory	~~CORRESPONDENCE~~ Complementary	TOTAL
27 hrs	4 hrs	31 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
15	11 Jul 75	3a, 3b

STS/CTS REFERENCE	
NUMBER	DATE
STS908X0	25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr.	14 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Multiple tank dish-washing machine	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Identify the standards for determining if foods, food animals and water supplies are safe for human consumption.

3b. Given applicable directives, forms, standards and necessary equipment, conduct medical evaluations of food service facilities and complete required reports. Satisfactory completion consists of attaining a score of not less than 70 percent of the total possible points when scored according to checklist 3ABR90830-IV-3b.

(Teaching steps listed in Part II)

ATC FORM 770

Audio Aids and Unclassified Materials Cont'd.

AABR00830-IV-1
21'163-S, Food Service Sanitation
Transparencies, Medical Aspects of Food Handling Series
16mm Film - FLC 2-55, Biology and Control of Domestic Flies (15 min)
16mm Film - FLC 2-78, Biology and Control of the Cockroach (15 min)
16mm Film - TF1-18104, The Rat Problem (25 min)

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LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
MSDV/Britz 14 NOV 1975	
COURSE NUMBER	COURSE TITLE
3ABR90930	Veterinary Specialist
BLOCK NUMBER	BLOCK TITLE
IV	Medical Aspects of Food Handling
LESSON TITLE	Medical Aspects of Insect and Rodent Control, Water Purification, Sewage and Waste Disposal

LESSON DURATION		
CLASSROOM /Laboratory	~~LABORATORY~~ Complementary	TOTAL
5 hrs	2 hrs	7 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
14	11 Jul 75	2a

STS/CTS REFERENCE	
NUMBER	DATE
STS908X0	25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	14 NOV 1975		

PRECLASS PREPARATION			
EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

2a. Identify the basic medical aspects of insect and rodent control, water purification, sewage and waste disposal.

(Teaching steps listed in Part II)

27 1-3

uphic Aids and Unclassified Materials Cont d.

3ARR00830-III-1
ARR00830-III-1
Film, FLC 3-83, The Compound Microscope (23 min)
Transparencies, Microscope Series

LESSON PLAN (Part I, General)

APPROVAL OFFICE AND DATE	INSTRUCTOR
CDW/Britz 3 NOV 1975	
COURSE NUMBER: 3AR90930	COURSE TITLE: Veterinary Specialist
BLOCK NUMBER: III	BLOCK TITLE: Microbiology
LESSON TITLE: The Microscope	

LESSON DURATION		
CLASSROOM /Laboratory: 4 hrs	~~MAINTENANCE~~ Complementary: None	TOTAL: 4 hrs

POI REFERENCE		
PAGE NUMBER: 13	PAGE DATE: 11 Jul 75	PARAGRAPH: 3a

STS/CTS REFERENCE	
NUMBER: STS903X0	DATE: 25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	3 NOV 1975		

PRECLASS PREPARATION			
EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Compound Microscope (1) Selected biological mounts (1) Lens paper (1) Sub-stage light (1)	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

3a. Given a compound microscope and selected biological mounts, correctly focus on a slide mount with both the 10X and the 43X objective lenses to an accuracy of 100 percent.

(Teaching steps listed in Part II)

APPROVAL OFFICE AND DATE	INSTRUCTOR
3 NOV 1975	
COURSE NUMBER	COURSE TITLE
[illegible]	Veterinary Specialist
BLOCK NUMBER	BLOCK TITLE
	Microbiology

LESSON TITLE
Microbiology Laboratory

LESSON DURATION		
CLASSROOM/Laboratory	~~LABORATORY~~/Complementary	TOTAL
2 hrs	None	2 hrs

POI REFERENCE		
PAGE NUMBER	PAGE DATE	PARAGRAPH
12	11 Jul 75	2a

STS/CTS REFERENCE	
NUMBER	DATE
S908X0	25 March 75

SUPERVISOR APPROVAL			
SIGNATURE	DATE	SIGNATURE	DATE
William E Beatty Jr	3 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
Selected bacterial cultures (15) Selected media and containers (3)	None	None	ST 3ABR90830-III-1 SW 3ABR90830-III-1 Transparencies,. Microbiology Series

CRITERION OBJECTIVES AND TEACHING STEPS

a. Given various food samples which have been stored or handled under differing conditions, correctly identify the effects of time and the various environmental factors on the growth of microorganisms. Record the results in SW 3ABR90830-III-1 with an accuracy of at least 70 percent.

(Teaching steps listed in Part II)

ATC FORM AUG 72 770

Teachable Aids and Unclassified Materials Cont'd.

SG 3ABB90830-III-1, Microbiology
ST 3ABB90830-III-1, Microbiology
SU 3ABB90830-III-1, Microbiology
Dorland, Medical Dictionary
Winokur and Buckes, General Biology (Outline)
16mm Film FLC 12-33, Life of the Mold (22 min)
16mm Film FLC 12-34, Louis Pasteur (28 min)
16mm Film FLC 13-138, Microorganisms - Beneficial Activities (15 min)
16mm Film FLC 13-139, Microorganisms - Harmful Activities (15 min)
16mm Film FLC 2-53, MA Bacteria (28 min)
Transparencies, Microbiology Series

APPROVAL OFFICE AND DATE	INSTRUCTOR
HQDV/Britz 3 NOV 1975	
COURSE NUMBER 3ADR90930	COURSE TITLE Veterinary Specialist
LESSON NUMBER	BLOCK TITLE Microbiology

LESSON TITLE
Principles of Microbiology

LESSON DURATION		
CLASSROOM/Laboratory 18 hrs	Complementary None	TOTAL 18 hrs

POI REFERENCE		
PAGE NUMBER 11	PAGE DATE 11 Jul 75	PARAGRAPH 1a

STS/CTS REFERENCE	
NUMBER STS908X0	DATE 25 March 75

SUPERVISOR APPROVAL

SIGNATURE	DATE	SIGNATURE	DATE
William E Britz Jr	3 NOV 1975		

PRECLASS PREPARATION

EQUIPMENT LOCATED IN LABORATORY	EQUIPMENT FROM SUPPLY	CLASSIFIED MATERIAL	GRAPHIC AIDS AND UNCLASSIFIED MATERIAL
None	None	None	See attached sheet

CRITERION OBJECTIVES AND TEACHING STEPS

1a. Identify the basic principles of microbiology, to include terminology, classification of organisms, morphology, metabolism, growth requirements, and control methods as applicable to food spoilage, food establishment sanitation, and zoonoses.

(Teaching steps listed in Part II)

1-3

TC FORM 770 AUG 72

STUDENT TEXT

3ABR90830-III-1
3AZR90870-2-I-2

Technical Training

Veterinary Specialist

Medical Aspects of Food Handling

VETERINARY MICROBIOLOGY

3-1

December 1975

SCHOOL OF HEALTH CARE SCIENCES, USAF
Department of Veterinary Medicine
Sheppard Air Force Base, Texas 76311

Designed For ATC Course Use

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Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas 76311

ST 3ABR90830-III-1
3AZR90870-2-I-2
December 1975

VETERINARY MICROBIOLOGY

OBJECTIVE

The information provided in this text will enable you to comprehend the basic concepts of microbiology as related to food spoilage, food preservation, food establishment sanitation, the control of zoonotic diseases and the use of the microscope.

INTRODUCTION

This text introduces you to the world of the microbe and their environment. It can in no way teach all that is known about microbiology; however, it will cover the primary areas of concern to the Veterinary Service.

INFORMATION

VETERINARY MICROBIOLOGY

MICROBIOLOGY may be defined by analyzing the Greek words from which it is formed - "micro" means too small to be seen by the naked eye; "biology" is the study of living things. Thus, the definition of microbiology is the study of living organisms too small to be seen with the naked eye.

Throughout the world, there are many hundreds of thousands of microbiologic plants and animals that will be of no concern to you as a veterinary service specialist; however, there are certain members of the plant and animal kingdom that you will be directly associated with. In the plant kingdom, there are the bacteria, yeasts, and molds. In the animal kingdom, you will be concerned with a large group of animal parasites which includes the protozoans. In a category all by themselves are the viruses which are too small to be seen without the aid of very special techniques and an electron microscope.

This text can in no way teach you all that is known about the field of microbiology, but when you complete this chapter, you should have a basic understanding of microbiology and its relationship to food spoilage, food establishment sanitation, zoonotic diseases, and the importance of proper sterilization and sterile techniques insofar as the veterinary service is concerned. In addition, you should know the proper procedures for preparing and submitting specimens to the laboratory.

1. Terms relating to Microbiology.

a. Listed below are some of the terms relating to microbiology. We have included them in this chapter for your convenience. Read them over before pursuing your studies further.

Antibiotic - antibacterial substance of biological or synthetic origin.

Antibodies - substances produced by and in an animal as a reaction to the presence of some foreign substance; usually to the protein fraction.

This supersedes STs 3ABR90830-II-1 and 3AZR90870-2-I-2, October 1974.

Antitoxin - a substance found in blood serum and in other body fluids which is specifically antagonistic to some particular toxin.

Attenuation - the process of weakening the pathogenicity of a microorganism or toxin.

Chemotherapeutic Agent - a chemical agent used in the treatment of diseases which is harmful to the causative agent, but not to the patient.

Cilia - minute hairlike outgrowths.

Endotoxin - a toxin that is retained within the producing cell until the cell disintegrates.

Exotoxin - a toxin excreted by the producing cell, while it is alive, and found in the cell's environment.

Flagellum - a slender whiplike part used for locomotion.

Free-Living - organisms which do not require another animal or plant body in which to carry on their life activities; they have the ability to produce their own food from inorganic substances.

Immunity - the ability of an individual to resist or overcome an infection to which most of the species is susceptible.

Micron - a unit of measurement equivalent to 1/1,000,000th of a meter or 1/1,000th of a millimeter.

Parasite - a plant or animal living in or on another live plant or animal host at the expense of the host and without compensation to the host.

Pathogenic - giving origin to disease or to morbid symptoms.

Saprophite - a plant living upon dead or decaying organic matter.

Toxin - any poisonous substance produced by plants or animals.

Vaccine - a preparation used to produce an active immunity.

Vector - a carrier, usually an arthropod (louse, tick, flea), which transfers an infective agent from one host to another.

Virulence - the relative ability of an organism to overcome the defenses of the host.

b. Were any of these terms or their definitions unfamiliar to you? If so, review where necessary before continuing, and you will find the rest of this chapter easier to comprehend.

2. Cells.

a. Before you understand microorganisms, you must understand the living cell. The cell is the basic unit of all living things. Whether an organism be microscopic or macroscopic, the smallest living plants and animals are composed of only one cell and, of course, the largest of the plants and animals are made up of many millions of cells.

b. All cells are composed of a basic living substance called protoplasm. This protoplasm is arranged into the different substances that compose the cell. The typical cell is made up of an outer covering known as the cell wall, a layer directly beneath

this called the cell membrane, a viscus liquid called cytoplasm, and a central body called the nucleus. As the protoplasm is organized into the components of the cell, it is given a different name. The protoplasm that makes up the nucleus of the cell is called nucleoplasm. Cytoplasm is the protoplasm found between the cell wall and the nucleus, and the cell membrane is a tight arrangement of protoplasm that can be compared some what to a plastic bag. It serves as a sack or covering for the cell. The cell wall in plants is a rigid cellulose substance serving as a final outer covering that gives the cell rigidity.

c. Some of the other structures that may be observed within the cell are vacuoles or inclusion bodies. Vacuoles are usually food substances. Within the nucleus of a stained cell you may see a central body known as the karyosome. As far as we are concerned, its only function is, by its size and shape, to aid in the identification of the cell. The nucleus of some cells display a beady or lumpy granulation distributed on the inner surface of the nucleus membrane of a stained cell called chromatin. This may also be of help in the identification of the cell. Figure 1 shows the typical cell and its morphology. A careful study of this figure will give you a clearer understanding of the cell and the relationship of its parts.

d. The aforementioned characteristics pertain to the "typical cell." If you compare a plant cell with an animal cell, you can see a major difference. Plant cells have a cellulose cell wall. Animal cells have a cell membrane. In fact, this is one of the characteristics that differentiates the two.

e. The smallest plant is a bacterium made up of only one cell. The largest and most complex are the seed-producing plants. The smallest animal is the amoeba and the largest is probably the whale. Regardless of the size of the plant or animal, it is composed entirely of cells or cellular matter organized to enable the organism to carry on its life functions.

3. Microorganisms.

a. There are many ways to divide microorganisms; however, we will divide our study of microorganisms into four areas: bacteriology, mycology, animal microorganisms, and viruses. Let's discuss bacteriology first.

b. Bacteriology. Bacteria are one-celled microorganisms that belong to the plant kingdom. They are plants because they have a rigid cell wall, but unlike the typical cell, a bacterial cell does not have an organized nucleus. The nucleus is said to be diffused throughout the cell. Figure 4 shows that bacterial cells occur in a number of shapes: round, called cocci; oval or elongated into rods, called bacillus; and a third group known as pleomorphic, which means many shaped. Another group of bacteria is shaped like little coil springs and are called spirochetes or spirilla. The shape of a particular bacterium is one of the main criteria used in its identification. Another major factor in its identification is the way cells are arranged or grouped together. An arrangement grouped in clusters like grapes is called staphylo. Therefore, round bacteria (cocci) appearing in clusters are called staphylococci. Some cocci arrange themselves into pairs. Paired organisms are called diplo, thus the term "diplococci." Still another group of cocci form into long chains. These organisms are known as streptococci. The bacillus organisms, or rod-shaped bacteria, may align themselves into chains or pairs and these may be called streptobacilli or diplobacilli; however, these terms are not often used. The spirochetes vary from a loose spiral to a tightly coiled spring. They may be short or very long. They always appear as individual cells and do not form clusters or chains.

c. The pairing, chaining, or clustering of bacterial cells is a result of the organism's method of reproduction. The cells multiply by a process called binary fission (fission is to split; binary means "two"). One organism splits into two organisms just like the parent cells. The pleomorphic bacteria are just what the name implies, many shaped. They appear as nodular filaments or short clumpy rods or possibly even Y-shaped organisms.

d. In addition to different shapes and groupings, some bacteria have special structures that aid in motility or survival in nature. Some bacteria possess an outer coating known as a capsule. The capsule may be so thin that it is undetectable. Others have a very thick sticky capsule composed of a complex sugar-fatty-protein substance. It is believed that this capsule aids in the organism's survival against the white blood cells in the body, and possibly some other hazards the cell may encounter in nature. To enable them to move about, some of the bacilli have special structures called flagella. A flagellum is a hair-like appendage that whips back and forth and either pulls or pushes the organism about. Some cells may have a single flagellum on one end. Others will have several on one or both ends, while still others may be completely covered with flagella. The sole purpose of flagella is for movement and is an aid in identification.

e. Another of the special structures that develop in certain of the bacteria is the spore. Any time these organisms find themselves in an unfavorable environment, they concentrate their protoplasm into a little round ball and become extremely resistant to the unfavorable condition. When the spore is formed, you can clearly see the rigid cell wall with the little round ball inside. This spore formation enables the organism to survive conditions that normally destroy bacteria. One species, Bacillus anthracis, has been known to live for as long as 40 years outside of the animal's body, and some organisms can withstand boiling for as long as 2 hours.

f. The Gram Stain. Bacteria, because of their small size, are difficult to see even with a good microscope unless they are properly stained. They may be stained with almost any aniline dye, but the most common staining reaction used in bacteriology is the Gram stain procedure. It is used because it differentiates between two major groups of bacteria. Almost all bacteria may be placed in one of these two groups. They are either Gram-positive or Gram-negative. Those organisms which are Gram-positive have a substance in their protoplasm known as magnesium ribonucleate. The presence of this substance is determined by the Gram-staining reaction. The organisms are first stained with crystal violet stain. Next, they are placed in an iodine solution. The iodine serves as a mordant or fixative which causes the crystal violet stain to become fixed to the ribonucleate substance. Ethyl alcohol is then flowed over the slide and the "unfixed" stain is washed away. Naturally, if the ribonucleate substance is not present, all the crystal violet stain is washed away. If ribonucleate is present, the fixed portion of the stain remains in the organism. After the alcohol destaining process, the organisms are subjected to a secondary stain which is usually safranine red. Any stain will suffice so long as it contrasts well with crystal violet. Those organisms with the ribonucleate substance are blue or violet and are Gram-positive, while those without ribonucleate stain red and are Gram-negative. Thus the Gram stain procedure not only stains the bacterial cell so it may be seen but places it into one of two major categories which aid in its identification.

g. Cultivating bacteria. It is almost impossible to study or identify a single bacterial cell. Therefore, we grow or culture bacteria in the laboratory under controlled conditions. Bacteria are cultured by planting them into a nutrient substance at a temperature that meets their environmental requirements. This substance is called culture medium. It must contain the nutritional requirements and proper moisture, and have sufficient buffers in it to somewhat eliminate the waste products produced by the bacteria. If all the nutritional environmental requirements are met, the organisms continue to grow and reproduce as long as the conditions remain favorable. If the culture medium is a clear liquid, the growth is obvious after a few hours. The liquid becomes cloudy. If the medium is a semisolid, the organisms grow into a visible colony and may look like small mounds of gelatins. The characteristics of the colony are noted and are major factors used in the identification of the organisms.

h. We may add certain chemicals to culture media that will allow some bacteria to grow and inhibit the growth of others. One chemical additive is common NaCl (table salt). While some organisms grow well, others cannot grow at all in high concentrations of NaCl. This is also a factor in an organism's identification. These chemical additives are

called inhibitors. When they are added to a culture medium, the medium is called an inhibitory medium or a selective medium, meaning it will sustain the growth of only select organisms.

i. There are other chemicals that may be added to media that cause the bacteria to produce specific colors in the media or in the colony itself. These are known as differential media. Media production has become so well developed, is so selective, and so differentiating that most pathogenic bacteria can be placed in specific groups and some can be completely identified by the use of culture media and the Gram stain alone.

j. Environmental requirements. Environmental requirements have been referred to a number of times in previous paragraphs of this chapter. You should understand fully just what environmental requirements are. Since there are many different kinds of bacteria, we can expect to find almost as many different environmental requirements. Probably the easiest way to approach the subject is to discuss it in general, without being concerned about specific organisms.

k. Since a bacterium has no mouth, and absorbs its food directly through its cell wall, its food must be part of its environment. The first requirement then must be nutrients. Different kinds of bacterial organisms have different nutritional requirements, so you can begin to see why some bacteria are found in one substance, while other organisms are found in another substance.

l. A second requirement is the proper moisture content. Organisms that are motile would naturally require more moisture than organisms which are nonmotile and are content to sit in one place all the time. In any case, however, there must be sufficient moisture to sustain life.

m. Temperature is a very critical requirement for bacteria. Most of the pathogenic (disease-producing) bacteria are adapted to body temperature. When this temperature is lowered, the organisms cease to grow; when it is elevated, they also cease to grow, and sometimes die.

n. Those organisms that require temperatures close to body temperature are called mesophiles. However, the thermoduric are capable of surviving temperatures much higher than body temperature. The psychrophilic group grows well in temperatures well below body temperature, and the thermophilic group of organisms grow best well above body temperature.

o. Another important factor in bacterial environment is the pH (acid concentration) of the medium. Organisms that grow well in an acid medium will not grow in an alkaline environment and vice versa.

p. In short, a particular bacterium, in order to reproduce or grow, must have the proper temperature, nutritional requirements, moisture, and pH. To all of these, we must add the oxygen requirements. Some organisms use atmospheric oxygen and are called aerobic organisms. Some organisms cannot grow in the presence of free oxygen. These organisms utilize combined oxygen and are called strict anaerobes. Another group may grow equally well in the presence or absence of free oxygen and are known as faculative organisms. When all of these environmental requirements are met, the organisms grow very well. As we stated before, some varieties reproduce every 15 minutes.

q. When a single organism is placed in a favorable environment, it seems to remain for a while without change. This is the lag phase. The length of the lag phase varies with different kinds of organisms. Then, for seemingly no reason, the one divides into two. Two becomes four, four becomes eight, and so forth. This is the logarithmic growth phase. Then, as the waste products build up or the nutrients deplete, the growth slows down and stops. This is the stationary phase. If the organisms are not transferred into a more favorable environment, or if they have no means of resistance such as spore formation, they begin to die. This is the death or decline phase.

r. Toxin production. As the organisms grow, they produce waste products and sometimes excrete other substances used in digestion. These products may be poisonous to us and we call them toxins. Toxins produced by living organisms are called exotoxins. As the bacteria die and break up, some of them release toxins from inside the cell, and these are called endotoxins. In either case, these are the substances that make bacteria harmful. The organism may invade the body and produce endotoxins or exotoxins that have a direct effect on the cells of our body or they may infect a food substance and contaminate it with toxins. When we eat the food substance, the toxins may be absorbed and poison our bodies. Some of these toxins may be destroyed by heat and are known as thermolabile. Some toxins are not affected by heat and are called thermostable. Cooking the food may kill the bacteria but does not necessarily make it safe to eat.

s. By now you can see that bacteria in their simple one-celled form are actually very complex little organisms. Although you hardly ever see them in nature, you must be aware that they are ever-present in your own environment. They are a part of your everyday life. With most of them you live in harmony, but occasionally one happens along with which you are not compatible. It may be severe enough to cause an illness that puts you in bed for weeks or it may be mild enough to merely taint the taste of the food you eat. Nevertheless, you are constantly in contact with these "wee beasties" and they play an important role in the performance of your duties as a member of the veterinary service.

t. Mycology. Mycology is the study of mycetes, a group of microscopic plants. The study of the mycetes presents one major problem from the very beginning, the very difficult terminology that has developed in this area of microbiology. The common name for mycetes is fungus. Fungi are broken down into two more common groups, yeasts and molds, with which you are more familiar. Because of the complexities of the terminology used in mycology, we will only use those terms necessary to give you a basic understanding of the subject and its application to the veterinary service.

u. The fungi are small plants. They have no roots, stems, or leaves, and possess no chlorophyll. Chlorophyll is the substance used by most plants to convert carbon dioxide, water, and sunlight into sugars to be used as food substance. Without chlorophyll, the plant cannot produce its own food substance and, therefore, must depend upon some other source for its livelihood. This other source may be dead or decaying matter, a manufactured food product, or a living organism. We have already mentioned that fungi are commonly called yeasts and molds, though we refer to an infection of these as a fungus infection. To avoid confusing the issue, we should point out the difference between a yeast and a mold.

v. Fungi reproduce sexually or asexually. Some species can reproduce only asexually. This asexual method is known as budding. A portion of the cell swells to a certain size, then seems to pinch off from the parent cell. Yeasts reproduce in this manner. In sexual reproduction, the cells branch and form male and female reproductive cells which unite and cause the production of spores (seeds). These spores contain all the ingredients necessary to produce another colony. The fungi that reproduce sexually are called molds. Now, strangely enough, some fungi are capable of both sexual and asexual reproduction.

w. Fungi do not look at all like typical cells. The yeasts are round or oval and much larger than the bacterial cell. They have a large vacuole taking up a good portion of the cell and usually a few large granules between the vacuole and the cell wall. The internal characteristics are of no importance to you in their identification, which is based almost entirely on the type of colony the yeast produces. The colony may be rough or smooth; its margins may be entire (unbroken) or irregular. It may appear dry or moist, and it may be any color in the spectrum. Some consideration is given to the nutritional and environmental requirements of the fungus; however, these factors are not nearly as critical as with bacteria.

x. As the molds grow, they produce flowery-looking colonies of many colors. If you look very closely at one of these colonies, you will see many hair-like structures called hyphae (hi fee). After a period of time, you will discover little beadlike or podlike objects associated with the hyphae. These "objects" are spores or packets of spores. If you study the growth of the colony, you can observe the entire process of the sexual reproductive phase of the fungus. It would take many pages of this text and complex terminology to explain the entire process of sexual reproduction of the fungi. That is exactly what we are trying to avoid, so we will just say that identification of the mold colony is based on its size, shape, and color; the size and type of spores and packets of spores produced; and a number of other factors that are used for final confirmation. Some of the more common molds you can learn to recognize at a glance, but it is best to leave the identification to a qualified laboratory.

y. Like bacteria, fungi are everpresent in our environment. Some are beneficial to us, and some are harmful. The beneficial ones convert milk to cheese, starches to sugar, and ferment sugar to alcohol. Penicillin and several other fungi are used in the production of antibiotics. There are many industrial uses of fungi. On the other hand, there are the undesirable fungi. Some are pathogenic to plants and animals, and some others are undesirable because they cause food spoilage. They are very difficult to control. Spores are found on everything; they blow around in the air and can grow on almost anything that hints at being a food substance. Some fungi will even grow on wet wood or paper. Temperature variation doesn't seem to be too vital to them; however, different temperatures, change some of the colony characteristics. At certain temperatures, the yeast organisms develop well while at another temperature, perhaps only the mold organisms are able to grow. Because of their prevalence in nature and their association with diseases, food spoilage, and industrial uses in food and medicine production, they are of prime concern to the veterinary service.

z. Microorganisms of the Animal Kingdom. We have already established the fact that bacteria and fungi are more plentiful throughout the world, and there are many thousands of different kinds of bacteria and fungi. We will now look at another group of microscopic organisms which in no way match the number of species of their plant cousins. They, however, offer a much greater variety of shapes and forms and are much more difficult to find and identify.

aa. Among the microscopic members of the animal kingdom is the Protozoa, the simplest form of animal life. There are many different species of Protozoa that are free-living in rivers, lakes, and ponds, but the Protozoa you will be concerned with are those of medical importance. A protozoan is defined as a one-celled animal. To be more specific, "proto" means the first - or the precursor to - the first form of something, as prototype. "Zoa" is a combining form to designate animal. In other words, protozoan is defined as the first or most basic form of animal life.

bb. A protozoan differs from the typical cell in that it is a true member of the animal kingdom and does not have a cell wall. Its outer covering is the cell membrane, and like the plastic bag, is quite flexible. It does possess all the other parts of the typical cell, including an organized nucleus, the vacuoles, cytoplasm and all. In fact, some of these one-celled animals have parts not included in the typical cell. Some of them have flagella or cilia which are organellae of locomotion. Some have a cytostome, which is a kind of primitive mouth. Others have a structure that is basically a primitive excretory organelle. (An organelle is an organ or part of a cell with a special function.) These organisms then are as different as dogs and cats. Not only are there marked differences in the species but noticeable differences within the species. The only way to identify the Protozoa is to memorize the characteristics of each class, genus, and species. Take into consideration the slight variations in the species and look for them.

cc. There are four classes of Protozoa to be considered. The first class is the sarcodina. The common name for sarcodina is amoeba. Amoeba are one-celled animals that vary greatly in size, and have no definite shape. They look much like a raw egg, carefully broken into a cold frying pan. They move about with pseudopods. Pseudopod may be

defined as "pseudo" meaning false, and "pod" meaning foot, or, in other words, false feet; a method of extending a portion of the cell membrane, then flowing the rest of the contents of the cell into it. The amoeba is illustrated in figure 02. The recognizable parts are (1) the cell membrane; (2) the cytoplasm; (3) inclusion bodies (vacuoles) in the cytoplasm; (4) the nucleus; (5) the chromatin granules of the nucleus; (6) the karyosome, or central body in the nucleus; and (7) the pseudopod extended in the direction the amoeba is moving. The extension of the pseudopod gives rise to number (8) in the illustration which is a band of ectoplasm, a clear area of protoplasm between the cell membrane and the cytoplasm.

dd. Some of the factors considered in the differentiation of the amoeba are the general size, kinds of inclusion bodies, number of pseudopods, size of the nucleus, size and location of the karyosome, and the distribution of the chromatin. The amoeba multiply or reproduce asexually by binary fission. An organism reaches maturity; the nucleus divides; then the cell divides into two cells, each taking half the contents of the parent cell.

ee. When conditions become unfavorable to the organism, most of the amoeba form a "cyst," much like the bacteria forming a spore. Cyst formation, or encystation, as it is called, occurs very rapidly. The amoeba ejects all of its undigested vacuoles, concentrates its nutrients into a single vacuole, then concentrates the proteins of its cell membrane into a tough outer shell, and sits tight as a little round ball. All movement stops and the little cyst waits for conditions to become favorable once again. During this period of waiting, the cyst uses the stored nutrients and the nucleus continues to divide. The number of divisions is constant for the species; therefore, the number of nuclei in the cyst may aid in its identification. When environmental conditions become favorable again, the cyst absorbs its leathery shell, divides its cytoplasm among its nuclei and goes its merry way.

ff. A second class of Protozoa are the mastigophora. A less difficult name for them is flagellates. They are the Protozoa that move by means of flagella. They, like the amoeba, are one-celled animals, but are possibly a little more complex because they have a definite shape, and of course, flagella. Some of them have cytostomes, which are openings that compare to the mouths of the higher animals. Some of them have developed specialized flagella that fold back across the cell body to form something that looks much like the fin of a fish. This specialized flagellum is called an undulating membrane because of its wavery appearance and motion. The general shape and anatomical parts of a typical flagellate are (1) the cell membrane, (2) the nucleus, (3) the cytoplasm, (4) an axostyle (a rigid bar within the cell that offers some support for the cell shape), (5) karyosome, (6) the flagella, (7) the undulating membrane, and (8) the cytostome, which, if present, lies in a groove in the cell called (9) the oral groove. Some flagellates form cysts like the amoeba. When encystation occurs, the flagella are withdrawn into the cell body and the tough cell membrane is produced. Normal reproduction is asexual binary fission.

gg. A third class of Protozoa are the ciliates. The ciliates closely resemble the flagellates. The major differences are the organellae of locomotion, which are cilia instead of flagella, and a micronucleus and macronucleus. Cilia are short hair-like structures that completely cover the cell. The anatomical parts of a typical ciliate are (1) the cell membrane, (2) the micronucleus, (3) the macronucleus, (4) the cytostome, (5) the oral groove, (6) the cilia, and (7) the vacuoles or inclusion bodies. The ciliates reproduce by binary fission and incorporate a sexual reproduction phase in their life cycle. The organisms conjugate (join at their cytostomes) and exchange micronuclei. The organisms then separate. The micronuclei and macronuclei fuse together, then begin a series of divisions that result in the formation of new nuclei; then the cell division follows.

hh. Before proceeding to the fourth class of Protozoa, we should note that all but two of the medically important members of the first three classes of protozoa inhabit the intestinal tract of man and animal.

ii. The fourth class, Sporozoa, are obligate parasites of the red blood cells and are commonly known as malarial organisms. Malaria is a disease transmitted from host to host by mosquitoes and is a disease of human beings. It is of little importance in the area of veterinary science in the military service; therefore, we will avoid the Sporozoa and save you the trial of learning the concepts of double life cycle reproduction.

jj. There are a number of other animals that are microscopic and infect man and animal. Among these are a variety of worms that are just a little too small to be seen by the naked eye. The members of importance to you will be covered in later chapters where more time can be devoted to individual species.

kk. There are a large number of intestinal parasites of man that are not microscopic. In fact, some of them are 20 to 30 feet long. These are the common roundworms, hookworms, tapeworms, and flukes. Although the size of the adult parasites vary, the eggs of these animals are all microscopic. Most of the eggs leave the host body in the feces. In order to pass the infection along, the eggs of some species may be eaten directly by the new host. Others require that the eggs be eaten by an insect such as the mealworm, the flour beetle, or the flea. The insect is then eaten by the new host. Still other species require that the eggs be deposited in the proper environment and hatch to form larval forms, which penetrate the skin of the new host; or begin a passage through a variety of intermediate hosts before eventually winding up in the primary host. For example, the eggs of the fish tapeworm are passed in the human stool. They hatch in fresh water releasing a larval form which is eaten by a water flea. The water flea is in turn eaten by a minnow, which is eaten by certain species of pike. The larva undergoes a number of changes in each new host, and when it finally reaches the pike, it becomes a mature larva, migrates into the flesh, and becomes a cyst. When the pike is finally eaten by man, if it is not properly cooked, larva is released into the intestine and develops into an adult tapeworm.

ll. It is not essential that you learn the life cycles of the parasites of man. However, you must be aware that there are microscopic forms of these animals that are infectious to man, and most of them are transmitted to man through the food he eats.

mm. Thus far in this chapter we have been discussing bacteria, fungi, and parasites that are infectious or incidental to man and his environment. We have not associated specific organisms with specific diseases, and it is beyond the scope of this chapter to do so. It is essential that you understand the prevalence of disease-causing food and waterborne organisms, and how a basic knowledge of microbiology can aid in their control. This can best be illustrated by the application of microbiology to a situation of which you may actually be a part.

Problem Situation: Let us assume that you are a veterinary technician assigned to a large base in the Middle East. You are called into the hospital commander's office one morning and told that one of the Army Communication Sites in the northern part of the country has reported 75 cases of severe diarrhea in the past 24 hours and is requesting help in determining the cause of the outbreak. You are to be part of a team sent to the site to make the investigation. The team consists of personnel from the Department of Military Public Health, medical laboratory, veterinary services, and statistical personnel. When you arrive at the site, you discover that the total military personnel number 500, and the cases of diarrhea now number 225. How would you proceed with an investigation to determine the cause of the outbreak and make recommendations to prevent its recurrence?

In solving this problem there are a number of factors that must be considered. The first is to determine which organism is responsible for the outbreak. Diarrhea or dysentary may be caused by an amoeba, Endomoeba histolitica, or one of several bacteria that are pathogenic to the intestinal tract. Shigella and Salmonella organisms are famous for causing outbreaks of diarrhea among armies all through history.

It is the laboratory's responsibility to name the culprit, and they immediately proceed to do so. At the same time, Military Public Health begins its examination of the site's water supply. This is necessary to insure that the chlorine residual is sufficient and the water is not polluted. You and the statistical personnel find out how many dining facilities are available on the site and where they are located. While the statistical section of the team continues with its thousands of questions, you begin your preliminary investigation of the eating establishments.

The dining hall is the first area you visit. The NCO dining room of the dining hall hall has been set up as an isolation dining room for the people who are ill, and all food and drink are being served in paper plates, paper cups, and plastic utensils that may be discarded after use. This eliminates the possibility of spreading the disease back into the remainder of the dining hall and kitchen. Your first impression is that the entire dining area and kitchen are very clean and sanitary, and of course, there is a crew of men busy cleaning right at that moment. This is understandable, because at any time there is an outbreak of this type on an installation, the chow hall falls under the "gun." This is a point to remember, because many things may be bright and shiny now for the first time in months. You make your observations and ask a few questions, but you cannot draw any conclusions. It is very difficult to receive straight answers - everyone is on his guard. You note no real discrepancies so you proceed to the other dining areas.

The NCO Club Open Mess, Enlisted Men's Open Mess, Officers' Club, and Exchange Snack Bar have all been closed by the post doctor. The one thing you notice in common with all of them is a crew of men working desperately to "get the place cleaned up." After checking the eating establishments, you go to the post cold storage area and procurement.

Cold storage seems to be up to [illegible] and you find that eggs and fresh vegetables are supplied by a local source in town, [illegible] the atmosphere is the same as in the dining establishments - one of hostility and evasion. No one wants to be a scapegoat for this outbreak, and the tendency is to cover up discrepancies. This, of course, makes your job much more difficult than it need be. Knowing something of the nature of the micro-organisms that cause such an outbreak, you already know that you probably will not be able to find the original "bugs" still sitting around waiting to infect someone else.

You return to the tent-bed post dispensary where your headquarters has been set up. The laboratory has prepared scores of media for bacteriological culture. You obtain your swabs and make a second round of the eating establishments. You must remember to adhere strictly to the prescribed standard methods for obtaining specimens. When you use these methods, your tables of comparison will give you an indication of the level of sanitation of the food service facility. Returning to the lab, you assist the laboratory personnel in setting up the cultures. This is about all that can be done on the first day.

The next morning there is a conference of the team. Military Public Health reports that records indicate the chlorine residual in the post water supply has been sufficient with no breakdowns for the past few months. The laboratory has isolated a Shigella from the patients. Total diarrhea cases now number 273. Statistics show that the outbreak is confined to the enlisted personnel. The chow hall employs 60 indigenous personnel who serve four meals per day. Questioning enlisted men of all ranks, the statistical team discovered that there is very little association of the men with the local people off base. Your plate counts after overnight culture do not indicate anything unusual, or any contamination on eating utensils or dishes.

Before proceeding, see if you can list the important facts that have been accumulated in the first twenty-four hours of the investigation. Your list should look something like this. (1) The onset of the outbreak was sudden, 273 cases in less than 72 hours. (2) The outbreak was confined to the enlisted personnel. (3) The post water supply has been eliminated as the source of infection. (4) The causative agent is a

bacterium called Shigella. (5) The dining hall employs 60 local food handlers. (6) Fresh produce and eggs are purchased for the dining facilities from a local source. From this list of facts, what conclusions can you draw?

Based on the listed facts, the disease is foodborne. It must come from an establishment that caters to the enlisted men and not the officers. It is unlikely that the snack bar would serve 273 out of 500 personnel an infected meal, and the clubs may be eliminated because the infection involves both NCOs and lower grade enlisted men. This points a crooked finger at the chow hall.

At this time, if you are not familiar with Shigella, you are obligated to do a little research on the subject. Probably the best way to go about this is to check the post dispensary for any literature they may have or go to the laboratory personnel and ask. You have a basic understanding of bacteriology, but it is impossible to continue with this sort of an investigation without understanding some not-so-basic facts about the microorganism that is causing all the trouble. Your research tells you that Shigella is a human pathogen responsible for most outbreaks of bacillary dysentary. Its route of transmission is fecal-oral, usually transmitted on food. Its incubation period is from 1 to 4 days. It may be spread by human carriers and sometimes by flies.

With this information, every one's work is cut out for him for the next few days. The laboratory must determine if any of the food handlers are "carriers" of Shigella. This involves taking rectal swabs and cultures from each food handler. Military Public Health checks out the fly population. Statistics must prepare a questionnaire listing each food item served during the 5 days before the onset of the outbreak. They question all the patients to determine a common food eaten by them during this 5-day period, then question all the personnel who showed no symptoms to see if there is a single food the patients ate that they did not eat.

You, as the veterinary technician, must now look very closely at the dining hall and its methods of handling and preparing the food. You must ask questions. The more pleasant you are, the more cooperation you will get. Point the blame at something other than the food handler and you'll be surprised at the information you get.. Check the fresh fruits and vegetables that come from the local economy. How are they decontaminated? How are they stored? How much food is prepared at each meal? Are there leftovers? If so, how are they stored, and how long are they held? It may take some real doing to get all of this information. Get the food handlers to show you all of this themselves. If you are successful, you will turn over some interesting facts.

In this case, the fresh vegetables are brought from town every 2 days and placed in a 35° F. walk-in refrigerator, commonly called a reefer. In preparation for consumption the vegetables to be eaten without cooking were disinfected with the standard disinfectant which is "Disinfectant Chlorine, Food Service." You observe the food handler preparing these vegetables, and are satisfied that they are properly prepared.

As you inspect the storage reefer for these vegetables you notice there are some containers of leftovers from a previous meal stored in the same reefer. Some are covered with standard pan covers and some are covered with white, water-absorbing paper. There doesn't seem to be any special order in the way the vegetables and leftovers are stored. The vegetables look to be freshly washed and water is dripping from them onto the pans of leftovers. This is the first major discrepancy you noticed. The paper covering the pans is saturated, allowing the moisture to pass right through and into the contents of the pans. You request the laboratory to run washing samples on the vegetables. You are told that the commercial source in town washes and sorts the produce before delivering it to the post.

At the next team conference these facts are brought out. The food handlers are all negative for Shigella. The stored vegetables tested by the laboratory show heavy fecal contamination. Vegetables and leftovers are improperly stored in the same reefer. Statistics say the only food eaten by the affected personnel that was not eaten by the nonaffected personnel was steak smothered in gravy, served 3 days before the onset of the disease.

Checking again with the dining hall into the preparation of the smothered steak, you are told that the same menu was served at the midnight meal 36 hours before that one, and a portion of the steak was held as a leftover and then mixed and served with the infected meat. You can now draw an assumption that the leftover portion of steak was contaminated by the vegetables in the reefer.

In your followup work, you inspect the facility in town supplying the fresh vegetables. The produce is purchased, washed, and repacked before being delivered to the post. You note that there are no sinks in the washroom. Water is brought in by a rubber hose and the produce is washed in buckets. Followup lab work tells you that the city water supply is contaminated as is the wash water, and of course, the produce.

What recommendations can you make to insure that such an outbreak will not happen again? Would you recommend that the post find another source for vegetables?

Solution to Problem Situation: Experience tells you that in countries all over the world where levels of sanitation are low for one reason or another, all the fresh fruits and vegetables are usually contaminated. It is therefore necessary to take the precaution to see that the troops are not exposed to the disease-causing elements that people of those countries have learned to live with.

The supplier of the produce was instructed to install proper washing tanks for cleaning the vegetables. The post supplied the chlorine solution which enabled the supplier to decontaminate the produce before it was delivered. The storage reefer was organized at the post in such a way that the leftovers did not have to be stored with the produce. Before use, the produce was again decontaminated with the standard chlorine solution.

This problem situation is an actual case that occurred at an Army Communications Site in the Middle East. It is an excellent example of the power of a few little microorganisms that find themselves in a friendly environment. The organism Shigella was placed on the produce either by the use of human feces as fertilizer, through handling with contaminated hands, or by a contaminated water supply. The produce was stored in such a way as to allow contaminated water to drip into improperly stored leftovers. The leftovers were served to a population, and an epidemic occurred. As a veterinary technician, you are charged with the responsibility of preventing such a thing from happening. You must use your basic knowledge of bacteriology, mycology, and parasitology, not only in solving problems like the one stated here but in preventing problems such as this from arising.

nn. Viruses. There is still another disease-causing entity that we have not yet covered. These are ultramicroscopic agents called viruses. In the past few years, vast amounts of knowledge have been gathered about these little "bugs," but they are still a mystery to people outside the field of virology. They are so different from the other disease-causing agents that they cannot be compared with any of them. They are not plants or animals and only a few can be seen with an ordinary microscope. They do not fit our present biological definition of "living" organisms, nor do they die. They merely inactivate or disassociate themselves, but cause a living cell to replicate or reproduce them. They cause a wide variety of diseases in plants and animals. We therefore must mention them as disease-causing agents, but we leave the study of viruses to the virologist.

4. Sterilization

a. Now that you have a basic understanding of organisms that cause disease, we should devote some time to methods of killing or destroying them. This is accomplished by sterilization. To sterilize something is to rid it of all living microorganisms. Pay particular attention to the word ALL, because we are concerned with more than just the disease-causing organisms. Sterilization can be effected by any of three different methods: heat, mechanical means, and chemical means. Each of these can be divided into more specific methods. We will discuss each of these methods and show you how they may be employed.

b. Heat. Heat sterilization may be accomplished by direct flame, dry hot air, or moist hot air. Without a doubt, direct flame applied to the microorganism is the most effective. This is not always practical however. There are very few items that can be sterilized in this manner. A bacteriologist may "flame" a loop or a piece of glassware; however, you cannot expose liquids, plastics, rubber, or fabrics to fire without destroying them. An object can be sterilized by direct flame only if it can be heated to incandescence without causing damage. Size is also a limiting factor here, so once again, it is not too practical a method.

c. Dry hot air is satisfactory for sterilizing such items as glassware and metal items. Then, of course, the items must be protected from becoming recontaminated before they are used. All items must be wrapped in heavy paper and tied with string, then placed in a hot air oven at 170° C. (338° F.) for 2 hours. This method is also not satisfactory for such items as liquids, plastics, rubber, and fabric for the same reason that direct flame cannot be used. It's just too hot, so the moist hot air method has been devised.

d. True enough, boiling water will not sterilize, but if you apply pressure to steam you can raise it above the boiling temperature of water (100° C. or 212° F.). This becomes a very effective way to sterilize almost anything. Objects are first wrapped or covered securely to prevent contamination. In the case of liquids in sealable containers, the tops or seals must be loose to allow the steam to enter. The objects are then placed into an autoclave (pressure cooker) and exposed to live steam under pressure. Naturally, the higher the pressure, the greater the temperature. After much experimenting it has been found that 120° C. (250° F.) at 15 pounds pressure per square inch for 15 to 20 minutes is sufficient to kill all microorganisms. But, remember, you would not place anything in an autoclave that would be harmed by moisture, pressure, or increased temperature. The autoclave is the most common means of sterilization today.

e. Mechanical Means. A second method of sterilization is by filtration. This method is naturally confined to liquids. It is desirable in the sterilization of solutions of sugars, tissue extracts, etc., where extreme heat could have a damaging effect, such as the caramelization of sugar. The solution is forced through a filter into a closed sterile container. There are a number of ceramic filters available with known pore sizes. They are effective but difficult to clean. Asbestos pads are available with known densities that are used once, then thrown away. Because the pore sizes are so small, the fluid must be forced through them. This is accomplished by drawing a vacuum in the sterile container that will catch the fluid or by applying a positive pressure to the unsterile fluid. Either way is effective, but it is more desirable to use pressure with viscous fluids such as serum to avoid foaming on the sterile side of the filter. The most important thing to remember is that the container and filter must be presterilized before use.

f. Chemical means. The last method is sterilization by chemical means. This is most applicable to large surface objects, such as table tops, floors, etc. There are three terms you are familiar with that apply to chemical sterilization. They are germicide, disinfectant, antiseptic. Germicide (germ - microbe, and cide - to kill) is a solution that will kill all bacteria. It is effective if it is used in the proper

strength and as directed by the manufacturer. The word disinfect means to kill the infectious organisms, so a disinfectant solution does not kill all bacteria. It rids an object only of the pathogens and, even then, many spores remain. An antiseptic solution does not necessarily kill bacteria. It only renders them incapable of reproduction and it doesn't always work. Never assume something is sterile because it has been cleaned with an antiseptic. Never try to substitute one chemical solution for another and keep in mind that, as the chemical solution dries, it leaves a residue that may be harmful in some instances.

5. The Microscope

a. In historical perspective one may say that during the 17th century the microscope opened up the world of "microcosmos" (the world of small things) whereas the telescope opened up the world of the "macrocosmos" (universe). Scientists from many lands made contributions to reveal these phenomena and dimensions.

b. The microscope is indeed a wonderful piece of equipment and a precision instrument. You will receive excellent instructions in its use while attending the Veterinary Specialist Course. Therefore, it is not necessary to go into great detail here. Figure 03 shows the compound microscope which is common to most, if not all veterinary facilities. Locate this figure now and refer to it as we continue. Why? Because, without certain knowledge of its structural components and their functions, you are incapable of operating this sensitive instrument properly.

c. The microscope is primarily used to observe objects too small to be seen by the naked eye. Any object this small naturally must be held or mounted. Glass slides are used for this purpose. When examining such slides, take the following steps.

Step 1. Raise the body tube by using the coarse adjustment knob.

Step 2. Place the slide on the stage.

Step 3. Select objective to be used and turn it into line with the ocular by revolving the nosepiece. When revolving the nosepiece, observe closely to assure that objectives do not come into contact with the slide or other objects.

Step 4. Lower the objective with the coarse adjustment knob until the objective is very close to the slide. When using the oil immersion objective, lower it until it enters the oil.

Step 5. Look through the ocular, and slowly raise the objective by turning the coarse adjustment knob until the field comes into view. Never move an objective downward while looking through the ocular, as it may result in damage to the lens of the objective or the slide.

Step 6. Use the fine adjustment to get the best possible focus.

Step 7. Adjust the mirror and/or light.

d. A few, but very important precautions you should always observe in caring for your microscope are as follows:

Always cover the microscope when you are not using it.

Take care to prevent any parts of the microscope from coming in contact with substances which might corrode metal, damage the lenses, or dissolve the cementing substances with which the lenses are secured into the objective and oculars.

Use only lens paper to wipe the lenses. Never touch the lenses with the fingers as even slight amounts of perspiration may damage them. Xylol is the only agent which should be used in cleaning the lenses or in removing oil from the objectives.

Protect the microscope against direct sunlight and moisture.

After using, always turn the nosepiece into a position which brings the low power objective directly over the opening in the stage. This may prevent accidental damage to the objective.

e. As implied earlier, there are various types of microscopes. They range from the single lens, which is nothing more than a simple magnifying glass, to the very complex and complicated electron microscope. All microscopes are not operated in the same manner, nor do they require the same care. Therefore, before attempting to use this instrument, be certain you know what you are doing.

6. Collecting and Submitting Specimens for Laboratory Analysis

a. The most common error made by veterinary personnel in collecting and submitting laboratory specimens is improper labeling and packaging. We cannot emphasize too much the importance of:

(1) Labeling your specimens so there can be no doubt about their identification when they reach the lab.

(2) Using proper and adequate containers. (For example, if your specimen is a liquid, don't assume the container you are placing it in is leakproof; be certain. Or if the specimen requires a sterile container, it is essential that you not only make certain it is sterile but that it is kept sterile when you are collecting your specimen.)

(3) Using proper and adequate preservatives, including keeping your specimens at the proper temperature before packing.

(4) Making certain that your specimens are securely packaged and properly labeled. If the specimen is lost or delayed in mailing, or the primary container is broken or crushed, all of your other painstaking preparations were in vain.

b. Bacteria Specimens. As you know, there are many bacteria and they are everywhere. When you collect specimens of animal tissue to submit to the lab for bacteriological analysis, be sure to use sterile instruments. The skin where you make the incision should be thoroughly disinfected. Remove the tissue using your best sterile technique. Place the specimen in a wide-mouth jar and keep it refrigerated until it is delivered to the laboratory.

c. Histopathology Specimens. Histopathology specimens are generally collected in blocks not more than 5/10 centimeter thick. You should then place them in a clean wide-mouth jar of 10 percent formalin. Allow the tissues to fix for 12 to 24 hours. Transfer the tissue to a clean polyethylene bag or other suitable container, such as a rubber condom with 10 percent formalin. A word of caution - be certain you submit such specimens to the histopathology center designated for your base.

d. Toxicological Specimens. When poisoning is involved, select stomach contents, blood, liver, kidneys, urinary bladder, and parts of the intestines. Securely seal them in a polyethlene bag and preserve them by freezing. When submitting these specimens to the laboratory, pack them in a generous amount of dry ice to assure their arriving at the laboratory in a frozen state.

e. Virus Specimens. Submit tissue specimens for viral studies in a sterile solution of 50 percent buffered saline and 50 percent glycerin, packed in dry ice. Serum specimens should be frozen immediately and remain frozen until they reach the laboratory. Before submitting these specimens, make certain you are sending them to a laboratory that has the capability of identifying viruses.

f. You may be required to submit other specimens to a laboratory for analysis. If so, don't guess at the proper technique or method of collection; be certain. In fact, you should consult the proper authority before submitting all specimens, not only for the sake of local or area laboratory requirements, but someone's life could well depend on the accuracy of the laboratory's analysis.

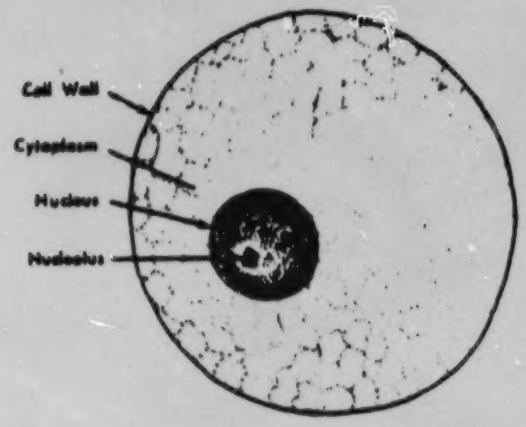

Figure 1

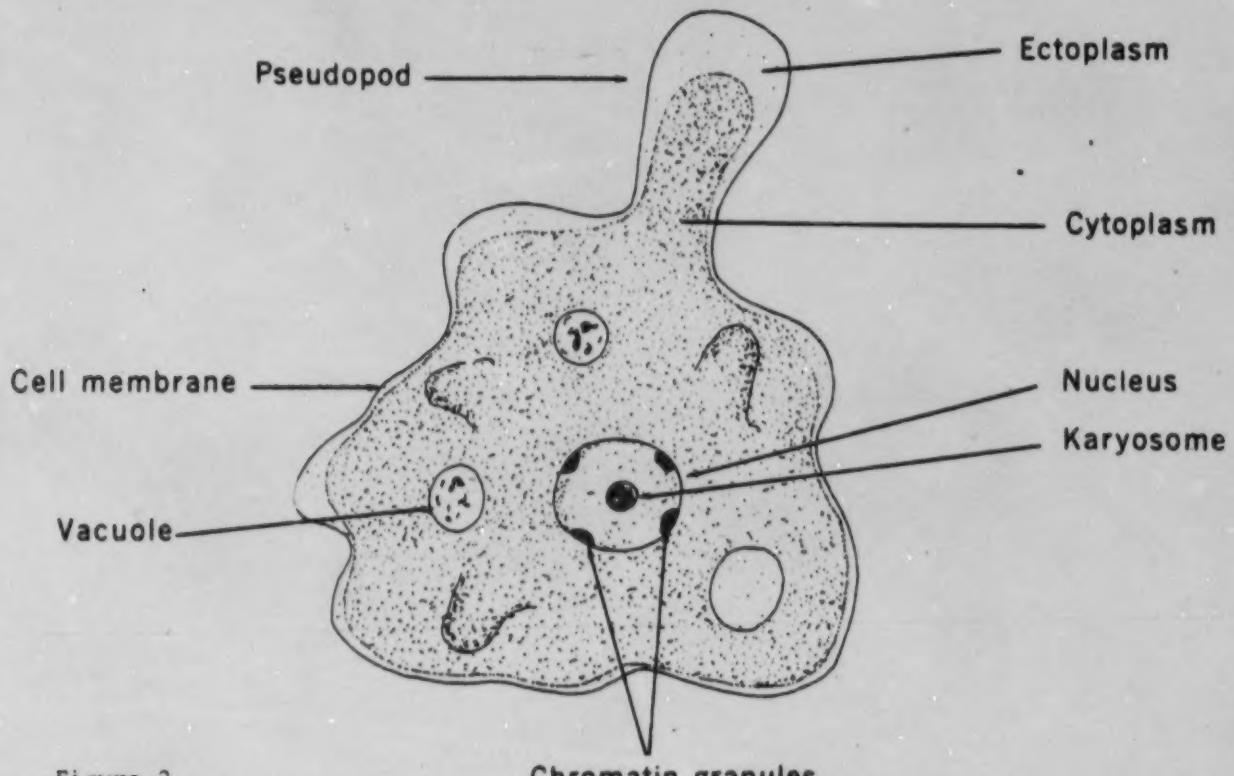

Figure 2

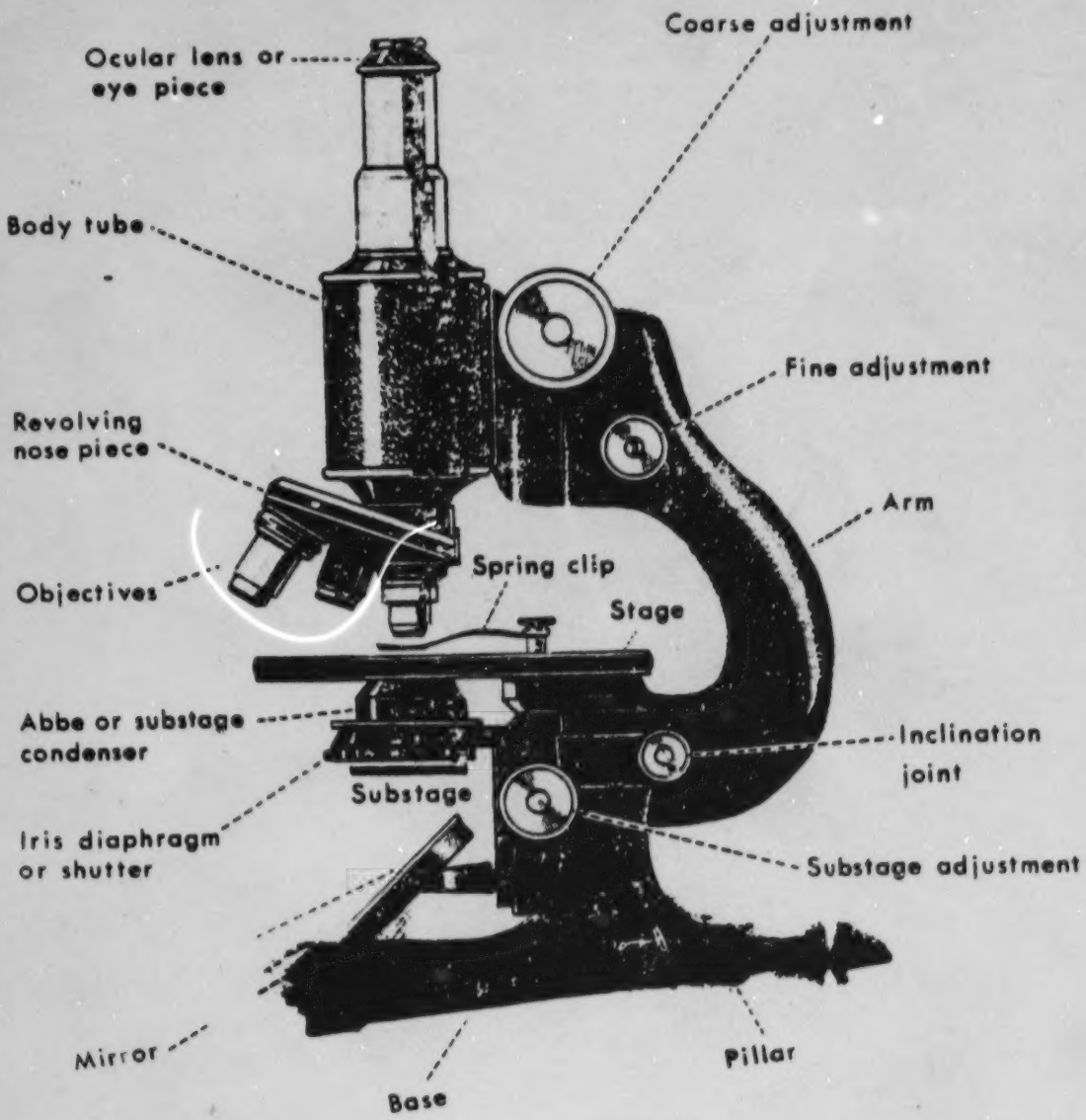
Ocular lens or eye piece
Coarse adjustment
Body tube
Fine adjustment
Revolving nose piece
Arm
Spring clip
Objectives
Stage
Abbe or substage condenser
Inclination joint
Substage
Iris diaphragm or shutter
Substage adjustment
Mirror
Pillar
Base

Figure 3

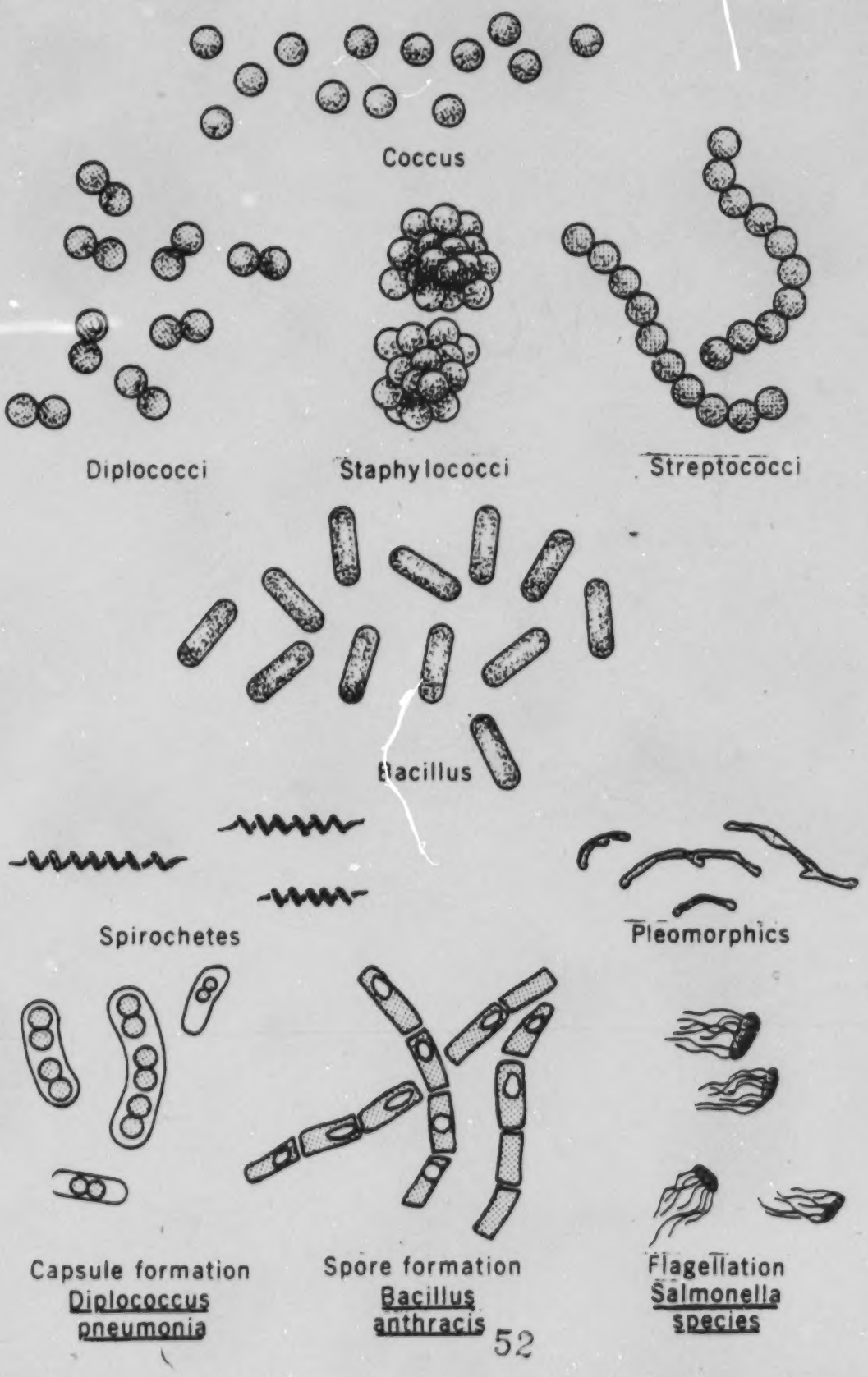
Coccus
Diplococci
Staphylococci
Streptococci
Bacillus
Spirochetes
Pleomorphics
Capsule formation
Diplococcus pneumonia
Spore formation
Bacillus anthracis
Flagellation
Salmonella species

Figure 4

DEPARTMENT OF VETERINARY MEDICINE

VETERINARY SPECIALIST

1-3

MICROBIOLOGY LABORATORY

November 1974

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

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Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

SW 3ABR90830-III-1
November 1974

MICROBIOLOGY LABORATORY

OBJECTIVES

The objectives of this Study Guide/Workbook are to supplement and complete lecture and laboratory material in the following areas:

1. Microbiological classification, growth requirements, and patterns of multiplication.

2. Laboratory demonstration of media, isolation and identification techniques, and examples of actual product(s) deterioration.

3. Definition of terms relating to the Study of Microorganisms.

INTRODUCTION

Microbiology is the study of the activities of microorganisms, and is normally concerned with unicellular (one-celled) organisms. Thus, the cell becomes the basic complete unit of life with nothing else alive being smaller or simpler. A basic knowledge of microbiology is essential in your work as a veterinary specialist. We concern ourselves with both disease producing (pathogenic) and non-disease producing microorganisms. This SW is designed to provide you this fundamental information by acquainting you with the classifications, characteristics, environmental influences, nutrition, and common terminology of microbes.

1. GENERAL CLASSIFICATION INFORMATION

a. SIZE: 300,000,000 microorganisms could be found in an area the size of a pinhead. A thimbleful would be equal to five times the national debt in dollars. They cannot be seen with the naked eye, but their presence can be seen as spoilage in the form of off-odors, color changes, slime, etc.

a - Q. Complete the below listed statements.

(1) Five times the national debt in dollars would equal _____ _____ of microorganisms.

(2) The presence of microorganisms is displayed by _____.

Answers on Page 5.

b - SHAPE: Microorganisms are classified by, among other things, their shape or morphological characteristics. As we are particularly concerned about bacteria, we will discuss them thoroughly. Bacteria are defined as one-celled microorganisms of the plant kingdom.

The three principle shapes are:

The round or cocci
The rod-shaped or bacilli
The spiral-shaped or spirilla
Pleomorphic or many-shaped

This supersedes SW 3ABR90830-III-2, August 1974 which can continue to be used until supply on hand is exhausted.

b - Q.

(1) Ball shaped or spherical bacteria are called cocci. Write cocci under the drawing(s) which represents cocci.

A____ B_____ C_____ D_____

Answers on Page 5.

(2) Bacilli are rod-shaped bacteria. Cocci are spherical. Correctly label the drawings below.

A_____ B_____ C_____ D_____

Answers on Page 5.

(3) Spirilli are curved or coil shaped bacteria. Identify and label the drawings below.

A_____ B_____ C_____ D_____

Answers on Page 5.

c. ARRANGEMENT OF BACTERIAL CELLS

(1) In addition to shape, the manner in which bacterial cells arrange themselves can be used in their identification. When cocci are found in grape like clusters they are called staphylococci. When they are found in chains they are known as streptococci. Indicate the appropriate name beneath the drawings.

A_____ B_____

Answers on Page 5.

(2) Cocci that are found in pairs are called diplococci. Indicate the appropriate name beneath the drawings.

A_____ B_____ C_____ D_____

Answers on Page 5.

(3) Bacilli in chains are called streptobacilli. Identify and label the drawings.

A_____ B_____

Answers on Page 5.

(4) Special structures can be used to identify bacteria. Some bacteria have hair-like projections called flagella. Identify the flagella in the drawings.

A_____ B_____ C_____ D_____

Answers on Page 5.

(5) Spores are special structures that are found as round bodies inside the bacterial cell. Label the structures below.

A_____ B_____

Answers on Page 5.

(6) Another special structure which certain bacteria have is a capsule. A capsule is a layer of slime covering the cell. Which of the drawing(s) below is (are) capsule(s).

A_____ B_____ C_____ D_____

Answers on Page 5.

Reading Assignments

1. Section 3, Microorganisms, pp 3-1 thru 3-19 in ST 3ABR90830-III-1.
2. Bacteriology - Toxin Production, ST 3ABR90830-III-1.

Answer Sheet (Pages 1 thru 4)

1 a. (1) A thimbleful

1 a. (2) Spoilage

1 b. (1) D

1 b. (2) B & C

1 b. (3) C & D

1 c. (1) A. Staphylococci B. Streptococci

1 c. (2) B

1 c. (3) B

1 c. (4) C

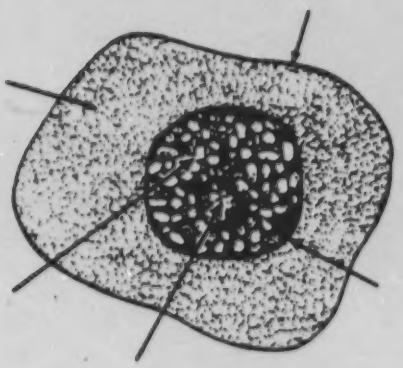
1 c. (5) A

1 c. (6) A & B

STRUCTURAL FEATURES OF BACTERIA

Below is a drawing of a typical cell. Utilizinn available references, identify the parts of this cell indicated by the lines.

Structural Features of an animal cell.



d. GROWTH REQUIREMENTS FOR MICROORGANISMS

(1) Nutritional Requirements - All biological systems share certain nutritional requirements and among bacteria there is a diversity of types. All living organisms require a source of energy for growth. Green plants require energy from the sun and are called phototrophs. Those organisms incapable of utilizing this radiant energy (animals such as man) must rely upon chemical reactions and are called chemotrophs.

(2) All living organisms require carbon in the form of CO_2 or some other complex form such as sugar. Organisms that can synthesize their own foods are said to be autotrophic (self-nourishing). Organisms which cannot synthesize their own food and must live at the expense of other living organisms or from decaying matter are called heterotrophs. Those organisms which exist from living organic matter are known as heterotrophic parasites and those which exist on dead organic matter are heterotrophic saphophytes.

d - 1 and 2 O.

(a) Plants that require radiant energy for life are called _____.

(b) Concerning nutritional requirements, man is an example of a _____.

(c) T - F. Man can synthesize his own food from inorganic matter.

(d) Match each term in Column A with the correct definition from Column B.

A - TERMS	B - DEFINITIONS
_____a. Autotrophic	1. Organisms which exist on dead organic matter.
_____b. Heterotrophic	2. Organisms which exist on only living matter.
_____c. Parasites	3. Able to synthesize their own food.
_____d. Saprophytes	4. Not able to synthesize their own food.
	5. Able to utilize nitrogen in the form of organic salts.

Answers on Page 9.

(3) Many organisms like man require oxygen in respiration; such forms of organisms are called aerobes. There are also many organisms that cannot live in the presence of oxygen. These are called anerobic. Other organisms will grow equally well in either aerobic or anaerobic environments. These organisms are known to be facultative. Another type of organism that utilized only a small amount of O_2 is called microaerophilic.

(4) In addition to oxygen requirement, the most important single factor concerning the fate of microorganisms is temperature. Every species has an optimum temperature, but is usually able to continue living (however, not reproducing) under adverse conditions. An organism that prefers cold and grows best at temperatures below 68°F is known as a psychrophile. The organisms which are of the most public health significance are those that prefer warmer temperatures (70°F to 100°F approx.) These are called mesophiles. A group known as thermophiles (heat-loving) exist at temperatures 45° to 60°C (140°F) and higher. These thermophilic organisms are of no medical importance, however, they can become a problem in dairy products. Some of these organisms are incubated at pasteurization temperatures.

d - 3 and 4 O. Match each term in Column A with the definition in Column B. Turn to page 8.

A - TERMS	B - DEFINITIONS
____a. Facultative	1. Does not require oxygen
____b. Mesophiles	2. Lives best at below 68°F
____c. Anaerobic	3. Are of no medical importance
____d. Psychrophiles	4. Prefers temperatures of about 130°F or above
____e. Aerobes	5. Utilizes a small amount of O_2
____f. Thermophiles	6. Requires oxygen
____g. Microaerophilic	7. Can live with or without oxygen
Answers on Page 9.	8. Are of most public health significance

(5) MOISTURE: All living organisms require water for normal growth processes. The nutrients must normally be in solution before assimilation. Bacteria require more moisture than yeasts or molds. Freezing eliminates available moisture thus preventing utilization and growth of the organism.

(6) ACIDITY OR ALKALINITY (pH): Cellular pH of the live organism is approximately 6.8. However, when the organism dies this may vary greatly. The pH of fresh meat is normally about 5.3 to 6.0. Hams and other phosphate processed products are alkaline (approximately 8.0).

d - 5 and 6 Q. T or F.

(a) Bacteria require more moisture than yeasts or molds.

(b) Organisms normally do <u>not</u> prefer a near neutral pH.

(c) Freezing does <u>not</u> eliminate moisture available to organism.

e. TECHNICAL TERMINOLOGY RELATED TO BIOLOGICAL SCIENCES

Utilizing the medical dictionary provided, in <u>your own</u> words define each of the following terms. Do not copy definitions from the dictionary. Page 10.

Answer Sheet (Page 7)

1 d (1 & 2) a. Phototrophs

1 d (1 & 2) b. Heterotrophs

1 d (1 & 2) c. False

1 d (1 & 2) d. 3 a
4 b
2 c
1 d

Answer Sheet (Page 8)

1 d (3 & 4)

7 a
8 b
1 c
2 d
6 e
4 f
5 g

1 d (5 & 6)

a. T

b. F

c. F

MICROBIOLOGY

AMINO ACIDS:

ANABOLISM:

ANTIBIOTIC:

ANTIBODIES:

ANTIGEN:

ASSIMILATION:

BACTERIOSTATIC:

CALORIE:

CATABOLISM:

CATALYST:

CHLOROPHYLLS:

CHLOROPLAST:

CYTOLOGY:

CYTOPLASM:

DIFFERENTIALLY PERMEABLE:

DIFFUSION:

ECOLOGY:

ENDOTOXINS:

ENZYME:

EPIDEMIC:

EXOTOXINS:

FISSION:

INFECTION:

KINETIC ENERGY

METABOLISM:

MICRON:

MILLIMICRON:

MORPHOLOGY:

MOTILE:

MYCOLOGY:

OSMOSIS:

PARASITE:

PROTEIN:

SOLUTION:

STERILIZATION:

SUSPENSION:

TURGOR:

VACCINE:

BACTERICIDAL AGENT:

MICROBIAL STASIS:

PATHOGENIC:

AUTOLYSIS:

CARRIER:

COLONY:

CONTAMINATION

CYTOLYSIS:

ENDEMIC:

GLUCOSE:

INHIBITION:

LIPID:

NUCLEOLUS:

NUCLEUS:

NUTRIENT:

PETRI DISH:

pH:

SPORE:

70

STAIN:

SYMBIOSIS:

TURBID:

ZOONOSIS:

SEWAGE:

REFRIGERATION:

PUTREFACTION:

DIGESTION:

ALCOHOL:

VITAMIN:

COLLOID:

OSMOTIC PRESSURE:

CARBOHYDRATE:

SAPROPHYTE:

CULTURE:

VIRULENCE:

FERMENTATION:

SPOILAGE:

COMMINUTED:

HALOPHILIC:

SANITATION:

LYOPHILIZED:

DISINFECTION:

ANTISEPSIS:

Laboratory Exercise

MICROBIAL NUTRITION

Fill in characteristics for each item during laboratory.

1. Media

   a. Liquid media (broth)

   b. Solid media (agar)

   c. Specialized media

      (1) Enriched

         (a) Blood (BAP)

         (b) Brain-Heart Infusion (BHI)

      (2) Isolation

         (a) Differential (EMB)

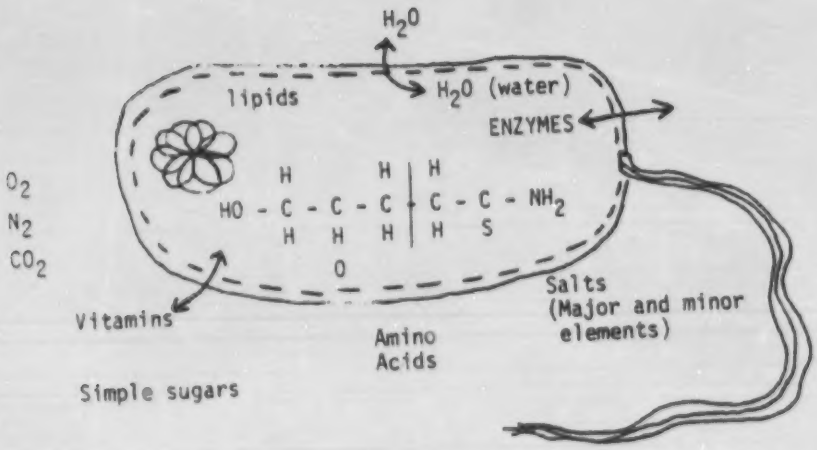
         (b) Selective (SS)

      (3) Biochemical

         (a) Urea

         (b) Triple sugar iron (TSI)

MICROBIAL NUTRITION: A bacterium is made of complex compounds (thousands of each type), and will often grow in a simple medium indicated by substances listed outside the cell.



ISOLATION/IDENTIFICATION

Students will complete each item during laboratory demonstration.

1. Dilution
2. Sterile "plate": Petri dish/plate (colonial characteristics)
   a. Streaked plate/mixed culture
   b. Poured plate/counts in volume or weight
3. Microscopic examination
   a. Staining (Gram +/-)

b. Cell shape/arrangement

c. Motility

d. Special structures

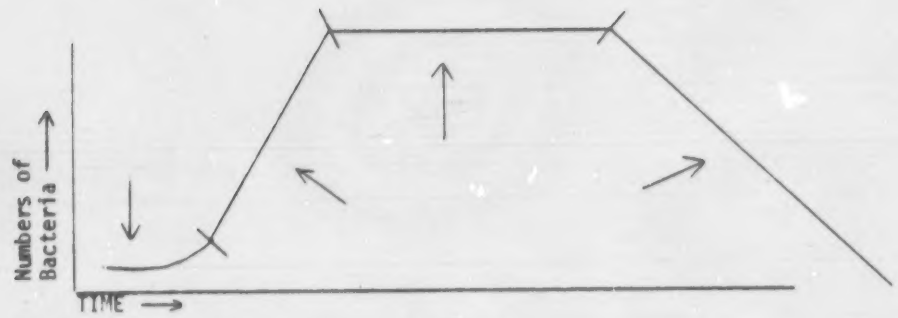
5. Animal inoculation

a. Pathogenic isolation

b. Biological test/production

GROWTH CURVE

Label each segment correctly.



GROWTH CURVE (Continued from Page 22)

Factors that affect the length (size) and angle of each portion of the growth curve:

1. Temperature
2. Osmotic pressure
3. pH
4. Nutrients
5. Moisture
6. Oxygen concentration

ATC-SHEPPARD AFB TEX. 79-720

DEPARTMENT OF VETERINARY MEDICINE

1-3

MEDICAL ASPECTS OF FOOD HANDLING

December 1974

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

DO NOT USE ON THE JOB

Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

ST 3ABR90830-IV-1
3AZR90870-2-II-1
30BR9921-1-III-1
December 1974

MEDICAL ASPECTS OF FOOD HANDLING

OBJECTIVES

Information provided will enable you to

1. Conduct medical evaluations of food service establishments and complete necessary reports.

2. Conduct medical evaluations of in-flight kitchens, aircraft, food and beverage vending machines, mobile units, and food production points, and complete necessary reports.

INTRODUCTION

Within the Armed Forces, the food service program is of tremendous magnitude. The budget for subsistence to feed our enlisted men alone runs over a billion dollars a year. There are over 5300 dining halls and more than 100,000 employees serving over five million meals a day. The enormity of the food service program along with the potential hazard of illness caused by food has brought about the need for medical evaluations of all military establishments serving food.

The Veterinary Service has the responsibility and the medical training to evaluate methods and provide assistance for the food service program. A background in basic microbiology will be needed to understand the concepts of temperature, time and special regard for those types of food that contribute to most foodborne illnesses. The knowledge acquired in this block will enable you to identify and correct most food handling discrepancies, train food service personnel in correct methods of food preparation and serving, and ensure that a high level of sanitation is achieved and maintained.

INFORMATION

In this text, we will be concerned with food service facilities, equipment, and sanitary handling and preparation of food. In addition, you will learn about the various illnesses which can be transmitted by improperly prepared or poorly handled food, and the procedures involved in investigating outbreaks of foodborne intoxication and foodborne infection.

Many things happen to food between the time it is prepared and the time it is consumed. More specifically, food is handled by humans who are likely to make mistakes. These mistakes could affect the health, comfort, and morale of the consumer. Therefore, it is very important that foodhandlers receive proper training in, and adhere to, sanitary practices concerning food preparation, food service, and equipment maintenance.

This supersedes ST 3ABR90830-IV-1, ST 3AZR90870-2-II-1, ST 30BR9921-1-III-1, July 1974

FOODBORNE ILLNESSES

"One Million Americans Victims of Foodborne Illness!" Fantastic? Yes, but this is the number of persons that the U.S. Public Health Service estimates are affected each year by foodborne illness. The saddest part of this commentary is that most, if not all, of this misery could be prevented. Why do these illnesses occur? Food poisoning or foodborne infection is caused by persons who prepare and serve food and who fail to apply known food protection measures. Acts of carelessness or ignorance lead to contamination of food with bacteria or with material which causes foodborne illness. Most foodborne illness is caused by bacteria; but there are other causes. This discussion will present various causes of foodborne illness as well as related information which should help you determine the best course toward your ultimate goal - prevention. The first step is a knowledge of the language to be used; therefore, we need to define several common terms.

Food Poisoning

Any poisoning, usually a gastroenteritis, of abrupt onset acquired through food. Foodborne intoxication is characterized by a grouping of cases in which the severity of disease is related to the amount of toxic food consumed. This suggests that it is due to preformed elements. It is caused by organic or inorganic substances including bacterial toxins.

Foodborne Infection

This indicates illness caused by ingesting food or drinks which contain microorganisms, such as salmonella, shigella, streptococci, brucella, tapeworm, etc. Foodborne infection is characterized by delayed onset of symptoms and the severity is not necessarily related to the amount of infected food consumed. This suggests that it may be due to multiplication of organisms after they have been ingested.

Contaminated Food

Food which contains the microorganisms or toxins capable of causing foodborne illness.

Infective Food

Contaminated food in which the disease producing organism(s) has increased in number to the extent of causing a foodborne illness in a susceptible unit.

Incubation Period

The amount of time necessary for symptoms to develop after ingestion of contaminated food.

Ptomaines

By definition, ptomaines are bases formed under the action of bacteria or of metabolism. Ptomaines are found in decaying or petrifying vegetation or animal matter where it causes much of the stench. Little, if any, foodborne illness is caused by ptomaines. Ptomaine poising is a term used by many uniformed persons to describe all forms of foodborne illness. In this sense, it is generally a misnomer.

Vulnerable Food

Food which is usually moist, high protein, and low acid.

Foodhandlers

All persons who will be present in places weere unsealed food or drink is handled, processed, prepared, or served and who contact food or food contact surfaces with any part of their body or their clothing, other than solely as consumers or purchasers of food. This includes duty in food service kitchens, bakeries, meat processing plants, and storage warehouses, flight kitchens, restaurants, food production points, snack bars and club bars where alcoholic drinks are served. Included in this category of personnel are cooks, cook's helpers, bakers, bartenders, meat cutters, waiters, dishwashers, diet supervisors, diet specialists, mess attendants, food service stewards and attendants, vending machine attendants and all persons who dispense ice cream or milk, such as base exchange attendants, plus household servants. The term "Foodhandler" also includes personnel assigned such duties on a temporary basis, except for kitchen attendants (KA), janitors, and delivery men if they never contact food as described above.

Now that the language is understood, we need information about the types of foodborne poisoning or foodborne infections often encountered. Also, we should be able to classify foodborne illnesses and to understand the symptoms and characteristics of each disease. Finally, we need to know the proper preventive measures for each type of illness.

FOOD POISONING

The most common cause of food poisoning or intoxication is bacteria, although poisonous plants and animals and chemical intoxication are occasionally the cause of serious outbreaks. Bacteria cause food poisoning by releasing toxic products into the food; many of these bacteria are constantly present in healthy individuals. Chemical intoxication is often caused by preparing or storing food in containers made of materials which are toxic to man. Some plants and animals are naturally poisonous to man, but are sometimes prepared for food when their danger is not properly understood.

Staphyloenterotoxicosis

Staphylococcus organisms are always present on our bodies, but luckily, not all types cause food poisoning. Only those specific types producing a toxin will cause trouble. Toxin-producing staph may be found in the mouth and nose, infected cuts, boils, pimples, and on dirty hands and arms. Boiling usually does not destroy the toxin produced by staph. The only sure-way to prevent staphyloenterotoxicosis is to prevent the bacteria from getting into food and/or storing the food under conditions which will not allow the staph to grow, even if present. Staphylococci grow and reproduce in warm, moist, high-protein foods. Custards and cream-filled pastries are especially susceptible to staphylococcus intoxication. Meats, egg products, and salads made from meat, eggs, or containing mayonnaise are also frequent offenders. At temperatures between 45° F. and 115° F., food can become toxic within 3 1/2 to 4 hours. Cold does not kill the bacteria, but it innibits the growth and reproduction processes. High temperatures kill the organism but may not destroy the toxin which has already been produced. Prevention is the key to control. Foodhandlers with open sores, boils, cuts, skin rashes, or gastrointestinal upsets should not be allowed to work until they are well and have been cleared for return to duty by a physician. Daily examination of foodhandlers by their supervisor is especially necessary to detect these problems. Education of foodhandlers, to convince them of the need to thoroughly wash their hands periodically throughout the day and after visits to the latrine, is a basic preventive measure. Use of wholesome products, clean utensils, proper handling techniques, and adequate refrigeration are vital. Finally, an important rule to teach is "Keep hot foods <u>hot</u> (above 140° F.) and cold foods <u>cold</u> (below 45° F.)." Symptoms of staphyloenterotoxicosis may begin to occur in less than 1 hour and usually reaches its peak in 3 to 4 hours. Symptoms may vary from mild nausea to extreme prostration with cramps, vomiting, and diarrhea. Recovery usually occurs within 24 to 48 hours; deaths have occurred as a result of staph food poisoning, but they are very rare.

Botulism

This spore-forming organism Clostridium botulinum, grows in an absence of air and produces a highly fatal toxin which affects man even in very small amounts. C. botulinum lives in decaying animals, soil, silt of lakes, and is often found in animal intestinal tracts. Food that comes in contact with contaminated soil picks up this organism, which then releases a toxin as it grows under anaerobic conditions. The toxin is destroyed by boiling for 5 minutes, but the botulinum spores are much more resistant. They may be killed by boiling for 5 hours at 212° F. (pressure cooker). This extreme killing requirement explains why underprocessed, home-canned, garden vegetables have been the source of numerous cases of botulism. Nonacid foods such as peas, beans, corn, and meat are the worst offenders. Symptoms of botulism vary considerably, depending upon the amoutn of toxin ingested. Symptoms may appear at any time between 2 hours to 6 days (usually 18 to 36 hours) after consuming the toxin. They may include double vision, loss of control of eye movement, and difficulty with speech, swallowing, and breathing. These symptoms may progress until there is complete muscular paralysis. Mortality rate is usually high (50 to 75 percent) and death may occur within 3 to 8 days after poisoning. Prevention of botulism is based on proper preparation of vulnerable foods. Home-canned, nonacid foods should be avoided. Inspect all canned foods and discard bulging cans. When in doubt, throw it out. Don't taste to determine safety.

Clostridium Perfringens

This is a toxin-producing, anaerobic organism which has, in recent years, gained considerable attention. It inhabits the intestinal tract of man and animals and is the most prevalent spore-forming bacteria in the soil. It is also a common cause of gas gangrene. The toxin produced is resistant to heat. Meats and poultry have been the chief offenders in outbreaks of foodborne illness involving C. perfringens. Unrefrigerated chicken broth provides an ideal culture medium. Rolled meat roasts, meat pies, and turkey are often the source of outbreaks. These types of foods or conditions afford the slightly anaerobic conditions which promote the growth and reproduction of C. perfringens. Improper handling and processing of poultry and meat increase the hazard of contamination. Improper removal of soil from vegetables has also caused outbreaks. Inadequate refrigeration, improper cleaning, and exposure of food to dust and air all contribute to the growth of Clostridium perfringens. Symptoms of C. perfringens foodborne illness are generally of short duration, usually 1 day or less, and complete recovery usually follows. The symptoms, which appear in 8 to 20 hours, include acute abdominal pain and diarrhea, chills, and fever. Nausea is mild, if present, and vomiting is uncommon. Controls and preventive measures generally involve proper preparation and storage of meat and poultry dishes. You should:

1. Serve hot immediately after preparation.

2. Cool (below 45° F.) leftovers rapidly and reheat (above 140° F.) them rapidly.

3. Use a meat thermometer to ensure adequate thorough cooking of thick cuts and interior portions.

4. Limit depth of stews, gravies, etc, to 4 inches for refrigerated storage.

5. Ensure proper techniques of handling and cleaning of vegetables and poultry.

Nonbacterial Poisons

In addition to bacterial poisons, poisonous chemicals from higher plants and animals can cause symptoms when consumed. Among the offenders that have caused outbreaks of poisoning are fava beans, water hemlock, rhubarb leaves, mussels, some species of fish, shellfish which have eaten poisonous plankton, and some mushrooms. Two species of mushrooms, both of the genus Amanita, are very dangerous. Onset of symptoms from these mushrooms may occur within minutes to 2 hours after consumption of A. muscarine, or from 6 to 15 hours if due to toxin A. phalloides. Other types of nonbacterial poisons are those which do not originate from plants or animals. These are the inorganic chemical poisons. Included in this group are insecticides which have been used on fruits and vegetables; copper and cadmium plated, enameled (antimony) or galvanized (zinc) pots and pans in which acid foods are prepared or stored; and lead, fluorides, and cyanides. These chemical poisons often cause violent symptoms which may begin in a very short time (10 minutes to 2 hours) after ingestion of the poison.

FOODBORNE INFECTIONS

In contrast to foodborne intoxication, foodborne infection is caused by organisms which enter the body through the food chain rather than by toxins produced by organisms or biological or chemical poison. There are numerous types of organisms which are capable of causing illness through foodborne transmission. They include bacteria, rickettsia, viruses, protozoa, and various parasitic helminths. The majority of cases are caused by bacteria; the salmonella and streptococcus groups are the most prevalent offenders; however, the virus causing infectious hepatitis is high on the list.

Salmonellosis

There are more than 1400 serotypes of salmonellae; among these is the notorious typhoid organism. Salmonella organisms cause a high percent of all foodborne infections; they are believed to be the most common cause of foodborne infection. The salmonella infections are common in animals and fowls; therefore, infection may result from eating improperly prepared, preserved, or cooked meats from these sources. Ground meat and sausage are especially vulnerable. Outbreaks often result from contamination of food from external sources. Foodhandlers, insects, and rodents may carry and transfer the organisms to food products. Rodents may contaminate flour and cause outbreaks from pastries and fillings. Similar circumstances present in outbreaks of other foodborne illnesses will be found in an outbreak of salmonellosis. These circumstances are:

1. Contamination of food capable of supporting growth of salmonella.
2. Favorable temperature (45° F. to 115° F.).
3. Sufficient time for organisms to multiply to a dangerous level (at least 4 hours).

Symptoms occur between 6 and 24 hours after ingestion (average 18 hours). They vary from slight nausea of short duration to severe headache, chills, fever, violent retching, colic, and diarrhea. Recovery may take from 1 to 3 days up to a week. Death has occurred, but is rare except in highly susceptible groups such as young children, the aged, and those otherwise ill. Control measures are similar to those involving other foodborne illnesses, and include:

1. Cleanliness of food and foodhandlers.
2. Noninfected foodhandlers.

3. Proper handling, thorough cooking, and adequate storage of susceptible foods.

4. Use of pasteurized dairy and egg products.

5. Use of eggs whose shells have not been cracked.

Streptococcosis

The causative circumstances surrounding a streptococcal foodborne infection generally parallel those of staphlococcus and salmonella outbreaks. The incidence of streptococcal foodborne infection is less and the symptoms are milder than those previously discussed. These symptoms may begin 2 to 18 hours after ingestion of infective food. They often include vomiting, colic, and diarrhea. The infectious agent is Streptococcus pyogenes, which causes sore throats and scarlet fever, and may be transmitted to food through droplet infections (spread by talking, coughing, and sneezing). Susceptible foods include poultry and eggs, potato salad, meat dishes, and low-acid foods. In addition to the controls for previously discussed foodborne illnesses, cleanliness and health (no upset stomach or sore throat) of foodhandlers and proper sanitizing of multiuse eating and drinking utensils should be stressed.

Infectious Hepatitis

Infectious hepatitis is a viral disease which occurs worldwide. Man is the reservoir. Sources of the infection are feces, urine, and blood from infected persons. The virus can be transmitted by person-to-person contact, through the fecal-oral route. It is generally transmitted through ingestion of contaminated food and water. Control and epidemiological investigation center around possible transmission by water, food, blood, or blood products. Special efforts should be made to improve sanitation and personal hygiene. Reduction of fecal contamination of foods and water should be stressed.

Miscellaneous Diseases

Many miscellaneous diseases not yet mentioned are transmitted through the food chain. These do not occur as often as those previously described. Among these are numerous intestinal parasites - such as pork, beef, and fish tapeworms, and other helminths; intestinal viruses - such as influenza; and bacterial diseases - such as brucellosis, TB, and many others such as the aflatoxin from the mold Aspergillus flavus. Many of these diseases are primarily diseases of animals, but are capable of infecting human beings through ingestion of the organisms in improperly prepared or processed foodstuffs, or by direct transmission from the animal. The source of infection is often food which has been improperly prepared or processed. Undercooked meats may contain tapeworms or trichinae; and raw milk from infected animals can often be a prime source of brucellosis, or diphtheria, or Q-fever, or bovine tuberculosis. In most instances, veterinarians control these diseases through vaccination of herds or slaughter of infected animals where a cure is not possible or feasible. In trichinosis control, cooking of raw garbage to be used as hog food is the primary preventive measure. Veterinary meat irspection both before and after slaughter further controls the transfer of many animal diseases. Control of the transmission point in some instances is the best method of prevention or transfer of many of these diseases. Pasteurization of milk is the intermediate control in brucellosis, Q-fever, and bovine tuberculosis. Pork must be cooked thoroughly to prevent trichinosis, and all other meats should be cooked adequately to control parasites. Thorough cooking (137° F. or higher) of all pork products is realistic and satisfactory positive control. Most foodborne illnesses are the result of:

1. Food contamination.

2. Adequate medium for growth.

3. Time and temperature.

If you eliminate these causes, you will probably arrest or prevent an outbreak of foodborne illness. If, despite all precautions, a susceptible food becomes contaminated with bacteria, time and temperature controls can and will interrupt bacterial growth. Most bacteria which produce toxins, or which contaminate food, are introduced in such small amounts that they are not initially a threat to health. But given enough time at favorable temperatures, they become quite dangerous. The temperatures at which these organisms thrive fall between 45° F. and 140° F. The time required for reproduction to a dangerous level is approximately 4 hours. It is important to note that this time interval does not necessarily have to be continuous. Bacterial reproduction arrested by chilling temperatures will resume when the temperature is again favorable. For these reasons a maximum cumulative 4-hour limit should be established for keeping vulnerable foods at temperatures between 45° F. and 140° F.

PREVENTION OF FOODBORNE ILLNESS

There are many facets to the prevention of foodborne illness. Of primary concern are foodhandlers, facilities, and equipment involved in preparing and serving food. This section will discuss the education and physical examination of foodhandlers, and the inspection of establishments and facilities.

The responsibilities associated with the prevention of foodborne illness lie to some extent with all personnel involved in the acquisition, handling, and processing of food. The base commander, of course, has the ultimate responsibility for sanitary operation of food service facilities and the enforcement of directives and standards pertaining to his organizations. The officer(s) in charge of food service facilities are directly responsible for operating the facilities and maintaining the established standards. The Medical Service has numerous responsibilities pertaining to food service sanitation and the prevention of foodborne illnesses. These responsibilities include the establishment of health standards for food service facilities and determining whether the facilities and equipment are adequate to maintain these standards; recommending adequate food service sanitation programs within the command; assisting in training food service personnel in personal hygiene and food service sanitation; and making recommendations for maintaining sanitary conditions in food service facilities on Air Force installations and in nearby civilian communities. When discrepancies are found, the medical inspector must be able to submit reports to the appropriate authority and recommend necessary corrective action in accordance with current directives.

PREVENTION BY EXAMINATION OF FOODHANDLERS

There are several distinct aspects to foodhandler examinations. Medical examinations are required prior to employment, periodically as required by the DBMS and, if necessary, following illness. Examination by Food Service supervisory personnel is necessary to ensure maximum day-to-day hygienic and physical well-being of foodhandlers.

MEDICAL EXAMINATIONS

All foodhandlers will have successfully passed a medical examination before performing any duties involving food handling in appropriated or nonappropriated fund food service activities. The Major Command Surgeon and Director of Base Medical Services (DBMS) will determine the necessity, frequency, and extent of subsequent examinations. Under certain circumstances such as in CONUS, periodic examinations may not be necessary. Medical examinations are designed to reveal chronic illness or medical problems which may exist at the time the examination is made. Clinical tests are made to ensure that foodhandlers are free from active tuberculosis; to assure that salmonella, shigella, or Endomoeba

histolytica are not being discharged in the stools, and to determine that pus-forming or other dangerous organisms are not being discharged from chronically infected ears, nose, skin lesions, mouth, etc. In addition, freedom from parasite ova is desirable but not mandatory, and determination of infectious viral hepatitis should be made when possible. Immunizations for the appropriate geographical area must be kept current. Results of medical examinations are recorded in the medical records folder. AF Form 535, Medical Certificate - Foodhandler, will be prepared in duplicate by the foodhandler's organization. The medical qualifications will be filled out and signed by the examining medical officer for each food handler. The original will be sent to the foodhandler's immediate supervisor, and will be kept on file where the foodhandler is employed. The duplicate will be retained by the base veterinarian or military public health officer.

SUPERVISORY SURVEILLANCE

Daily supervisory examination of foodhandlers is a very important aspect of disease prevention and in the opinion of many, has equal or greater value than the periodic medical examination. This procedure, which is often overlooked, assures that hygienic standards and physical health, as best determined by visual examination, are maintained by all foodhandlers. Examinations and constant surveillance should ensure that the following requirements are met by all foodhandlers.

1. Bathe daily.

2. Keep hands clean at all times. They must be washed with soap and warm water when reporting for duty, immediately after each visit to a latrine, and after handling animals, fish, or fowl. In areas where this practice is not ingrained, the food service officer and supervisors will exercise maximum ingenuity to accomplish conformance.

3. Wristwatches and rings (except wedding bands) will be removed prior to and during food preparation and serving.

4. Keep fingernails clean and cut short.

5. Facial fair will be trimmed to 1 inch or less.

6. Wear clean outer clothing, preferably white in color, while on duty. The upper garments must cover the armpits. Foodhandlers will wear acceptable head covers, persons with hair longer than 6 inches will wear hair nets or strong-holding (lacquer-type) hair spray.

KITCHEN ATTENDANTS

Kitchen attendants (KAs) used in preparing food to be cooked will be inspected by the supervisor for cleanliness, absence of open wounds, and obvious infections (such as colds or boils). If local extenuating circumstances necessitate the utilization of KAs as servers of prepared foods, supervisors will maintain maximum surveillance over each operation in which the KAs are engaged.

PREVENTION BY FOOD STORAGE TECHNIQUES

Procedures and techniques used by food service personnel in storing, preparing, and serving food, rank high in importance when you evaluate the possible causes and prevention of foodborne illness. Some techniques are discussed in the sections on insect and rodent control, garbage and refuse disposal, and sources of foodborne illness. Techniques mentioned here are points of special emphasis. This discussion concerns you in two respects, i.e., improper foodhandling is conducive to foodborne illness and/or food spoilage. Proper temperature control is probably the most important aspect of storage.

Time limitation, types of containers used for storage, ventilation of storage areas, and the protection of stored food are other important considerations. Temperature control encompasses several aspects of food storage. The general rule is to keep hot foods hot (140° F. or more) and cold foods cold (45° F. or less). In addition, proper handling of frozen foods is important. Frozen foods will be defrosted in a well-ventilated cooler maintained at a temperature not exceeding 45° F. or cooked from the frozen state. Defrosted foods will be used as soon as defrosted, or held no longer than 24 hours. Leftover and/or defrosted foods will not be frozen. When it is impossible to defrost frozen foods as stated above, the frozen food may be held at room temperature for a maximum of 6 hours and then placed into a 45° F. cooler to complete the thawing during which time the surface temperature of the food should never exceed 45° F. Time is closely related to temperature control and may in certain instances be the determining factor in whether or not food is safe for consumption. Foodhandlers should know and adhere to the time limitations that are placed on holding food.

1. Defrosted foods must be used as soon as defrosted; they must not be held longer than 24 hours.

2. Leftover foods will be immediately [illegible]ed (time and date) and refrigerated and used within a 24-hour period. Food items which have gone directly from cooking to the refrigerator, such as large roasts and whole turkeys, may be held for 48 hours. Foods which are notably poor growth media for bacteria such as bread, fruit pies, and high acid content foods may be stored longer than 24 hours but should be used soon enough so that palatability is not lost, normally 48 to 72 hours.

3. Prewrapped or prepared sandwiches will be prepared not more than 36 hours before issue or sale, they must be consumed within 5 hours after preparation or, if refrigerated, below 45° F., they may be kept not more than 26 hours. In addition, sandwiches prepared with hot meats or other hot products will be for immediate consumption unless maintained at 140° F.

4. Vulnerable foods such as poultry, meat, water food, dairy, and egg products will be prepared in the minimum time before being served (4 hours or less) and, unless kept at a temperature of 140° F. or more, will be covered and refrigerated until time for serving and must be maintained above 140° F. or below 45° F. while on the serving line.

Particularly dangerous foods (hash, creamed soups, gravies, dressings, bread puddings, certain cheese or egg casseroles, creamed meats, etc.) will not be refrigerated in pans over 4 inches deep since the center of the mass will not be adequately cooled. Large bulky meat items such as turkeys, hams, and roasts cool slowly; therefore, they will be placed in a well-ventilated refrigeration unit immediately upon leaving a 140° F. (or higher) heating unit. The type of container used for storage of food is another important consideration. Containers must be clean, free from cracks or chips, and must not be made of a material (zinc, antimony, etc.) which can potentially convey a chemical poison to its contents. Furthermore, food containers must be placed on racks or dunnage to allow adequate ventilation. The minimum space required for proper ventilation is 4 to 6 inches from floors and walls in cold storage and 4 to 8 inches for products in dry storage. Stored foods should always be kept covered. The use of galvanized containers will be limited to the transportation and temporary storage of water, peeled raw potatoes in water and dry foods. Meat, fruit, salad, lemonade, tea, coffee, fruit juice, etc. will not be placed in them nor will they be used for cooking food. The can (not just the lid) should be labeled as to its contents. Detergents, cleaning agents, and other non-food products will be clearly labeled and stored in an area separate from food products.

PREVENTION BY DISHWASHING TECHNIQUE

All forms of pathogenic organisms, including the most resistant spores, are removed from dishes and other eating utensils, or killed, when proper dishwashing techniques are applied

EQUIPMENT AND UTENSILS

Equipment must be kept clean to prevent contamination of food. The best time to clean it is immediately, but not later than 3 hours after use. Soiled equipment will be cleaned and sanitized before use. Equipment in poor condition; chipped or cracked china, glass, or plastic containers; utensils with cracks, chips, or pits; or any utensil with roughness which makes thorough cleaning difficult will not be used. Cleaned and sanitized glasses, dishes, trays, and utensils will be stored in a manner to prevent contamination. Glasses, cups, bowls, etc. will be stored inverted on racks of suitable design to protect them from dust, dirt, insects, and fingers. Serving trays may be stacked inverted after they are properly cleaned and dried. Silverware will be stored with the handles presented to the user. Cutlery cylinders, and perforated sides and bottoms, will be used. These must be kept elevated above floor level.

DISHWASHING

Dirty china and trays are evidence of poor dishwashing. It will often bring more complaints to a Food Service facility than anything else. Often dishes and utensils may appear clean, but laboratory procedures by medical personnel may reveal large numbers of bacteria on them.

MECHANICAL DISHWASHING

Proper dishwashing is a combination of a number of distinct steps. An evaluation of dishwashing must take into account these steps and their relationship to the total operation. It is essential to examine not only the machine's capability, but also the work habits of the person who operates it. Dishwashing operations must comply with AFM 163-8, Food Service Sanitation.

Sorting

Usually sorting is accomplished on the bussing cart and at the dirty dish table. Like items requiring the same type of racks are usually sorted together. The silverware is placed in a hand dishwashing detergent solution for presoaking.

Waste Removal and Racking

Removal of gross soil and racking of the dishes is usually accomplished at the same time. Racks will be constructed of nonmarking corrosion resistant welded wire or plastic. The main problem areas in this procedure are insufficient waste removal, overloaded racks (dishes overlapped, stacking of bowls and cups) and use of the wrong racks. Flat items such as plates must be tilted in the rack, so that the eating surfaces are sprayed from above and the bottoms from below.

Prewashing

Each facility is equipped with either a hand hose and nozzle or a mechanical prewash unit integral to the machine, where the soil (food debris) is loosened with a water spray. The need to empty, clean and refill the wash tank is directly related to the prewash operation. If the person using the dishwasher is diligent in removing as much soil as

possible during this step, he will not have to change water in the wash tank as often. Spray dishwashers are designed to remove soil films, not large food deposits and cannot do the job adequately if large amounts of food are left on the dishes. The temperature of the prewash water should be between 110° and 120° F. This temperature range allows removal of food and grease from dishware.

Washing

This recirculating cycle involves a properly selected detergent solution of the proper temperature and sprayed forcefully against all food contact surfaces to accomplish the washing action. Wash water temperature should not drop below 140° F. Detergent activity is often decreased when the temperature exceeds 160° F. One most important factor of this operation is cleanliness of the wash arms. If they are clogged with food particles, string, lime deposits, etc., they lose efficiency and the machine's ability to wash is impaired. Another important factor is the concentration of detergent in the wash water. There must be some means of replenishment to off-set cross-dilution by the final rinse. The best way is by means of a detergent dispenser. If this piece of equipment is not present, a previously determined quantity of detergent should be added with each rack of dishes to accomplish replenishment. The wash water must be relatively free of small food particles which tend to stick to utensils being washed and resist rinsing action. The accuracy of the installed wash section thermometer should be checked periodically be removing a scrap tray and testing the water temperature in the tank with a hand thermometer when the machine is shut off. This may also be done in the power rinse tank.

Power or Intermediate Rinse

The function of this recirculating rinse cycle is to remove detergent and to heat dishes, etc. to a sanitizing temperature. The water temperature should not be below 160° F. nor should it exceed 180 F. Besides the sanitizing temperature provided, the increased heat causes the dishes to air dry rapidly and tends to reduce water spotting and films caused exclusively by hard water. It is important to check that the rinse arm tubes are open and free of foreign deposits that reduce their efficiency.

Final Rinse

This nonrecirculating fresh water rinse provides the thermal sanitization that is so vital to the protection of food contact surfaces from pathogenic organisms. The water temperature in this cycle should range between 180° and 190° F. The final rinse jets, being quite small, are subject to clogging from hard water scale deposits. Routine examination of these jets or nozzles should be done to be sure they are not materially reduced in size due to mineral build-up or plugged due to particles of scale from the hot water supply line.

Drying

Only air drying is authorized. If the dishes do not dry in about 1 minute, something is wrong. The finished dishes may not be hot enough to cause the remaining water to vaporize rapidly or poor ventilation in the dishwashing room may be causing the air to reach such a high humidity that it will not accept additional moisture. Trays and silverware are especially bad in this respect, but a shake of the rack will help dislodge most of the water droplets and enhance drying time.

Inspection and Unloading

Dishes must be allowed time to dry. If unloading is done immediately upon exit from the dishwasher, wet dishes will result. As the personnel unload the racks, they should inspect for dishes that were improperly cleaned. To aid them in this, an adequate level of illumination should be provided (50-100 foot candles). Inevitably, certain dishes will come through which have not been properly cleaned. These must be separated and rewashed.

Storage

Dishes and other food contact surfaces should be stored in such a manner as to reduce the chance of contamination to a minimum. Bowls, glasses, cups, and similar items should be stored inverted. Plates and saucers should be stored in lowerators or in cabinets.

HAND DISHWASHING

The most satisfactory arrangement for sanitizing food contact surfaces, other than with properly operated mechanical equipment, is by the use of a three compartment sink. Manual dishwashing involves certain prescribed and important procedures. First, the utensils must be scraped free of gross soil. Next, they are washed in a 110° to 120° F. detergent solution, in the first compartment sink, until all visible food particles and grease have been removed. From the first compartment, the utensils and tableware (including glasses, cups, trays, and silverware) are passed to the second compartment which contains clear, warm rinse water (usually about 150° F.). Here the soapy water that clings to them from the washing process is rinsed off. The third compartment is provided for sanitizing the utensils and tableware, and the hot water or chemical method is used. The hot water method is just what its name implies. Utensils are completely immersed for 1 minute or more in hot water maintained at a temperature of at least 180° F. The 180° F. temperature is not to be guessed at. A thermometer must be used to assure that this temperature is maintained. Water at this temperature is much too hot for a person to put his hand in. Therefore, a dishbasket, a dish rack, flatware container, or other container with a handle must be used to contain the dishes, etc., while immersing in the hot water. This permits easy removal of the utensils from the sanitizing compartment for drying. Whenever hot water sanitation is not available, the chemical method is to be used. The most common chemical compounds used for this type of sanitation are hypochlorites and iodophors. Chemical sanitation is best accomplished by immersing dishes, etc. into a 200 parts per million hypochlorite solution (100° to 140° F.) for not less than 2 minutes or into a 25-75 parts per million iodophor solution (75° to 125° F.) for not less than 1 minute. Equipment that is too large to immerse may be sanitized by a hot water (180° F.) spray rinse for 10 seconds, or by spraying or swabbing with a chemical sanitizer of proper strength. Only air drying is authorized.

SINGLE USE CONTAINERS

If proper dishwashing facilities are not provided at food establishments, disposable paper cups, paper plates, spoons, etc., will be used for serving foods.

PREVENTION BY FOODHANDLER TRAINING

Proper and adequate training of foodhandlers in the principles and practices of food service sanitation is of vital importance in the prevention of foodborne illness. AFM 163-8 requires that instruction in this subject be administered to all foodhandlers and supervisors. This training will be repeated annually or as often as the DBMS determines necessary to ensure that all foodhandlers, including supervisors, are aware of their responsibilities in disease prevention. The base veterinarian or other qualified medical service personnel will conduct the program. As a veterinary specialist, you may be asked to help present this training.

Adequate Preparation for Instruction

You must make adequate preparation and know your subject if you are to present a course of instruction. The more research you do to prepare yourself, the more self-confidence and poise you will have. As a result, your course will be more effective. If you are asked to conduct such a course, consult as many publications as possible that deal with the subject. The following are excellent.

1. AFP 161-22, Sanitary Food Service Instructor's Guide.
2. AFP 161-24, Handout Sheets - Sanitary Food Service and Personal Hygiene.
3. AFM 146-7, Food Service Management.
4. ESM 25-4, Exchange Service Food Operation's Manual.
5. Quantity Food Sanitation, Karla Longree.
6. Sanitary Techniques in Food Service, Karla Longree.
7. Foodborne Illness - Cause and Prevention, Kelly Vester.
8. Planned Sanitation - Prestige and Profit, Kelly Vester.

Scheduling of Classes

Scheduling of classes must be arranged jointly with the supervisory personnel of all food service activities concerned. The classes should be mandatory meetings approved by the base commander. Remember that the facilities cannot cease operation in order to attend the classes, each subject hour must be presented at least two times. As a suggestion, each class session could be given the last 1 1/2 hours of the morning shift one day and first 1 1/2 hours early, to attend their session; and the morning shift would remain 1 1/2 hours after going off shift, to attend their session. This would then be repeated for each subject hour.

Location of Classes

You will want a central location, accessible to all food service personnel. Too large a facility can be as undesirable as too small a facility; therefore, attempt to reserve a location (Service Club, Officer's Club, or NCO Club) that will accommodate the attendance and lend adequate effect (sound, light, ventilation, and seating) to the training environment.

Lesson Plans

Each lesson should be presented from a well-developed lesson plan. A lesson plan should include a stated objective of what the student is expected to learn from the lesson and should be outlined to show step-by-step development of the lesson. The Instructor Activity column should be used as a guide and not as a word-for-word lecture. After your lesson plans are developed, you should try a "dry run" to develop self-confidence and timing. Appendix B is an example of a typical lesson plan. Use this as a guide in building your course.

Certificate of Training

Upon completion of the course, an AF Form 1256, "Certificate of Training," will be signed by the officer in charge of the training program, and will be issued by the DBMS to each individual who satisfactorily completes the course of instruction. Minimum requirement for satisfactory completion will consist of attendance of 75 percent of the classes during the course of instruction, and a satisfactory grade on the examination.

Foodhandler Training Course

A Foodhandler Training Course, complete with lesson plans and caricature 35mm color slides, are available for use by veterinary personnel. Consult your command veterinarian concerning the availability of this material.

Our information thus far has been aimed at a basic course applicable to all activities. Your special needs should be determined by a review of the discrepancies frequently noted during surveys and inspections. In developing your course, keep in mind that you are training foodhandlers and not medical service personnel. Be careful of overusing medical terminology. Discuss only that material which the foodhandler has a need for, do not fill the course with material which is only nice to know. Remember - the most unpredictable aspect of foodhandling is the human element. You must try to convince the student that sloppy habits and faulty techniques on the part of the foodhandler are the most likely causes of foodborne illness. Motivate them to do their work correctly; in this way, they and the Air Force will benefit.

FOOD AND BEVERAGE VENDING AND PLANT INSPECTION

Whether it be coffee break, lunch, or midnight snack, chances are good that at least once a day you will take advantage of the convenience of a mechanical food or beverage dispensing device - the vending machine. Depending upon the size of the base, there are probably some 300 to 500 vending machines on your base. Ensuring the safety of the food and beverages obtained through these machines is an important part of the veterinary program. This responsibility has two distinct aspects: the machine, operator, delivery venicle, and area in which the machine is located; and the plant facilities and personnel involved in preparing, packaging, and storing the products for the machines.

The USPHS pamphlet, Vending Food and Beverages, and AFM 163-8, Food Service Sanitation, are the sources of the following definitions of terms that are pertinent to this section.

Vending Machine

Any device which, upon insertion of a coin or coins, dispenses food or beverage, either in bulk or package.

Catering Point

Restaurant, commissary, caterer, or any other place in or from which food, beverage, or ingredients are kept, handled, prepared, stored, or sold for subsequent dispensing through vending machines.

Machine Location

The room, enclosure, space, or area where one or more vending machines are installed and operated.

Readily Perishable Foods

Any food or beverage or ingredients consisting in whole or in part of milk, milk products, eggs, meat, fish, poultry, or other food capable of supporting rapid and progressive growth of microorganisms which can cause food infection or food intoxication. Products in hermetically sealed containers processed by heat to prevent spoilage, and dehydrated, dry, or powdered products so low in moisture content as to preclude development of microorganisms are excluded from the terms of this definition.

Hot Food or Beverage

Liquid food or beverage, the temperature of which at the time of service to the consumer is at least 140° F.

Product Contact Surface

Any surface of the vending machine, related equipment, or containers which come into direct contact with any food, beverage, or ingredient.

Adulterated

A food is adulterated if:

1. It bears or contains any substance which may be injurious to health.

2. It consists in whole or in part of any substance which is in any way unfit for human consumption.

3. It has been prepared, packed, or held under conditions which may have rendered it injurious to health.

4. The container is composed in whole or in part of any substance which may render the contents injurious to health.

Operator

Any person, who by contract, agreement, or ownership takes responsibility for furnishing, installing, servicing, operating, or maintaining one or more vending machines.

VENDING MACHINES - SERVICE AND INSPECTION

The safety of food or beverage received from a vending machine depends upon a combination of factors. The product must consist of unadulterated ingredients, prepared and delivered under sanitary conditions and held in a safe environment until purchased. The catering point must be maintained and operated in a sanitary manner and must be inspected and approved by the Medical Service. All products and ingredients intended for vending must be clean, wholesome, and free from contamination and adulteration. Wet storage is prohibited. The following types of food are prohibited for sale in automatic vending machines unless they are acidified below pH 5.0.

1. Ham salad

2. Egg salad

3. Chicken salad

4. Cream-filled pastries

Chilled vulnerable foods must be dispensed to the consumer in the individual original container or wrapper into which they were placed at the catering point, or be dispensed into single service containers. Sandwiches and other food items made of readily perishable ingredients are packed for vending machines must be permanently and conspicuously marked to show the date the item was prepared. These foods will be placed in the vending machine within 12 hours of preparation and removed from the machine within 24 hours. Similarly, fresh dairy products will be coded and delivered to the vending machine within 48 hours of packaging, and will be removed from the machine within 72 hours from placement. Frozen foods (ice cream and ice cream sandwiches) will be removed from the vending machine every 30 days. Readily perishable foods or ingredients within the vending machine must be maintained at a temperature which is less than 45° F. (for cold foods) or more than 140° F. (for hot foods). Machines must contain automatic shutoff controls so that any time the temperature varies above or below the limits, it will not dispense until served by the operator. In addition, machines must be provided with a thermometer,

accurate to ± 2° F., to indicate air temperature of the food storage compartment. While in transit, readily perishable foods must also be maintained at a safe temperature (below 45° F. or above 140° F.). The limitations stated thus far do not apply to carbonated beverages or canned or dried foods when the bottle, can, or package is dispensed sealed and subsequently opened by the consumer. Machines must be so located as to promote cleaning and eliminate insect and vermin harborage. They must be at least 6 inches from walls and floor, or mounted on rollers, or be small and lightweight so they may be easily moved. If adequate space is allowed between machines and walls, machines may be sealed to the floor to prevent seepage and insect and rodent infestations. The immediate surroundings of each vending machine must be maintained in a clean condition. All food contact surfaces of vending machines must be smooth, kept in good repair, and free of breaks, corrosion, open seams, cracks, and chipped places. All joints and welds in food contract surfaces must be ground smooth and polished. All internal angles and corners must be rounded to permit proper cleaning. All multi-use parts of vending machines which come into direct contact with readily perishable foods, beverages, or ingredients must be removed from the machine at least daily or at each servicing. These parts must be thoroughly cleaned and effectively sanitized each time they are removed. The DBMS will determine frequency of cleaning necessary for parts which come in contact with other than readily perishable foods. A record of all cleaning and sanitizing should be maintained at each machine by the operator. Prior to installation of any machine, vendors are required to furnish a certificate declaring that the machine meets construction specifications of the National Sanitation Foundation, NAMA, or other agency recognized by the surgeon as having an equivalent testing program. Upon entering the base, and before servicing machines, operators are required to stop at the veterinary office to have the products inspected. You should arrange to accompany the operator at routine or unannounced intervals to inspect machines for cleanliness and to ensure that operators are complying with directives on removal of readily perishable foods. These visits provide an opportunity to observe the conduct, habits, and appearance of operators and the areas in which vending machines are maintained.

PLANT INSPECTIONS - MILITARY STANDARDS EVALUATION

Products destined for vending machines, as well as countless processed food products for use by military installations, are prepared at numerous food-processing plants. All such plants must pass an inspection by the Veterinary Service and be listed in the Directory of Sanitarily Approved Establishments for Armed Forces Procurement. Plants are inspected by medical personnel who use an applicable Military Standard as a guide. In many instances, there are specific Military Standards which cover individual types of product processing, e.g., poultry processing, milk plants, bakeries, etc. For products for which no specific Military Standard has been developed, a general standard is used. Regardless of the product, there are general requirements covering most standards, which we will now discuss. Plants are rated and recommended for or against listing on the basis of a sanitary compliance rating (SCR) system. Plants which attain an SCR of 90 or above are recommended for listing in the Directory, provided no critical defects are recorded. When a critical defect is recorded, no SCR shall be computed and the establishment is not recommended for listing in the Directory. Sanitary requirements for a given type of plant are set forth in the applicable Military Standard. Reference Military Standard 668A, entitled "Sanitary Standards for Food Plants." The individual sanitary defects are given assigned defect points in column 2 of the checklist. They range in value from 0 to 5, and some are designated "critical." You may assign a numerical rating (0 to 5) according to your judgement of the magnitude or severity of the discrepancy. These assigned values are recorded in column 3. At the end of the inspection, total the defect points and enter them on the checklist. In instances where you consider the defect to be so gross as to constitute a serious health hazard, delete the numerical rating in column 2 and write the word "critical" in columns 2 and 3. Any time a critical defect exists, the plant cannot be recommended for approval. Critical defects must be fully explained in the remarks section of the checklist. Explain in sufficient detail to clearly describe the condition which resulted in this rating. If the rating

given precludes recommending approval, recommendations may be withheld pending correction of defects and reinspection. There may be defects listed on the checklist which are not applicable to the plant being inspected. If this occurs, line out the assigned defect points so that they are not included in the overall rating. If this is not done, the overall rating will be lower than you intend to give. Inspection checklists are contained as an appendix to the applicable Military Standards. Local reproduction of the checklist is authorized and will be necessary to supply your requirements. As previously stated, a plant must attain an SCR of 90 or higher to qualify for listing in the Directory of Sanitary Approved Establishments for Armed Forces Procurement. The formula for figuring the rating is as follows.

$$\frac{\text{Sum of column 2} - \text{Sum of column 3}}{\text{Sum of Column 2}} \times 100 = \text{SCR}$$

Plant inspection can be easily summarized by empnasizing the similarity between the requirements of any food processing plant and your local dining hall. All detailed requirements concerning building construction, employee health and hygiene requirements, water supply, utensil cleaning and sanitizing, etc., are the same. The exception is that health certificates must only comply with local requirements. You will be working with local health department authorities, but your recommendations will determine whether or not a plant is approved or disapproved.

FLIGHT FEEDING

The rules governing proper food sanitation are essentially the same wherever food is prepared and served. The basic rules of food service sanitation are at least as important, if not more so, in the operation of flight kitchens and flight feeding.

Principles of Flight Feeding

There are three basic aspects of flight feeding. They are preflight, inflight, and postflight feeding. Of these, the inflight poses the greatest problem, because storing, preparation, and serving of food in flight is limited by space and equipment, and crew mobility. These limitations may necessitate dietary deficiencies in inflight meals which must be fulfilled in preflight and postflight meals. These compensations must be made whether the food is prepared in special flight-kitchen facilities or in regular dining halls.

PREFLIGHT. An hour or two before takeoff, crew members should eat a freshly prepared and highly nutritious meal to provide energy necessary to maintain efficiency. This meal should be eaten slowly in a pleasant atmosphere. This will encourage relaxation and promote digestion. Diets must vary with the type of flying to be done. All foods should be well-cooked, low in residue, and should not contain excessive fat or spices. Crews who fly high-altitude flights should consume no carbonated beverages or gas-producing foods. These include beer, cabbage, dried peas, beans, turnips, and other fibrous vegetables and fruits. All foods should be safe!

INFLIGHT. Some degree of inflight feeding is now routine in most flight missions. Due to various limitations, inflight meals are often a nutritional compromise. This situation causes difficulty in providing a variety of attractive well-liked, properly prepared food and beverages. In order to overcome these difficulties, different types of meals and food service equipment are needed for each category of aircraft and each type of mission flown. These variations include:

1. Large numbers of troop-transport aircraft. The sandwich meal and the precooked frozen meal are used here. The sandwich meal consists of sandwiches or cold chicken, a beverage, and dessert (cereal is often used if served as a breakfast meal). The precooked frozen meal resembles a TV dinner; it is supplemented with canned fruit juice, bread, dessert, and a beverage. Flight attendants are responsible for preparing and serving these meals.

2. The crews of manned, bomber-type aircraft present a more complex feeding problem. Space and mission limitations dictate the use of the sandwich meal or the individual inflight food packet to meet these requirements.

3. The inflight feeding requirement is the most complex, for crews aboard high-altitude supersonic jet aircraft. Heavy clothing and equipment restrict movement, and oxygen masks must be worn. These people can snack only at intervals, if at all. To satisfy this need, bite-size meals are provided. These consist of small bites of steak, carrots, celery, fruit, and some liquid food. These meals must be appetizing and convenient to eat, since the appetite decreases at high altitude and heavy gear discourages efforts to eat.

POSTFLIGHT. After a long flight, crew members need and deserve to relax and refresh themselves. Long hours of concentration and fatiguing pressures generate tensions. High-altitude flight reduces the body's fluid level. Having a snack helps relieve tensions, becomes a reward for a good job, rehydrates the body, and aids in relaxation. It helps prevent chronic fatigue and stimulates the physiological processes and morale. Extreme cases of fatigue may justify special provisions for some light refreshments before or during postflight debriefing or other duties. A complete meal, containing mostly protein, should follow a long mission.

Flight Meals and Special Sanitation Requirements

When a person is required to fly in excess of 3 hours, one or more of the several flight meals should be available to him. An additional meal is required for each additional 6 hour period of flight. There are special sanitation requirements associated with some of these meals. We will discuss these as the meal is described.

FOOD PACKET, INFLIGHT, INDIVIDUAL. These are complete meals, consisting of four cans: one each of meat, fruit, crackers, and dessert, and an accessory pack. There are 10 menus available, each having different meat components, six of which are solid pack meats and four are meats mixed with other foods, such as noodles, eggs, and spegetti. The food packet is of a semiperishable nature and can be stored for 3 years from date of pack. Food packets should be rotated for use within the maximum recommended safe storage time.

PRECOOKED FROZEN MEALS. This meal consists of commercially processed main course food items. At present, five different menus are available; four are dinner-supper meals; one is a breakfast meal. This is not a complete meal and must be supplemented. Acceptable supplements include juice or soup, relish or salad, bread, butter, dessert, and beverage. The precooked frozen meal is perishable by nature. It requires careful handling and storage. It must be stored at a temperature of 0° F. or lower until ready to use. It should not be thawed prior to preparation. Under no circumstances should it be frozen or prepared for consumption after thawing. Recommended safe storage life is four months.

SANDWICH MEAL. This is a "box lunch" meal consisting of the following.

1. Beverage unit: soup, milk, tea, coffee, chocolate drink, fruit juice, or vegetable juice.

2. Meat component: two sandwiches; or one sandwich and fried chicken, or its nutritional equivalent.

3. Dessert unit: fruit, cookies, or pastry.

4. Optional items: vegetable relishes, dried fruits, nuts, candy, chewing gum, ready-to-eat cereals, sugar and cream, salt and pepper.

This is the most useful of the flight meals. It can be used as a breakfast, dinner, or supper meal. It can be planned from a wide variety of authorized foods, and it requires no installed aircraft equipment. The sandwich meal has storage and preparation restrictions and limitations. It must be stamped with the hour, date, and year prepared; and must be initialed at the time of preparation. It must be consumed within 5 hours after preparation if not refrigerated at 45° F. or less. Total time from preparation to eating, including all storage times at 45° F., will not exceed 36 hours. Sandwiches prepared for the sandwich meal must be prepared from fresh, acceptable basic ingredients. The basic ingredients are bread, a moistening agent, and an appropriate filling. Only sliced meats, poultry, or cheese are appropriate for sandwich fillings; chopped or ground mixtures must not be used. Use of such mixtures could cause digestive disturbances. All ingredients should be refrigerated until the sandwiches are prepared - this includes bread. If not refrigerated, bread could act as a warm blanket which would promote growth of organisms which might be present on the filling material. When sandwiches become outdated, they must be thrown out. Other components which present no hazard may be reused.

FOIL PACK MEAL. This is a full meal, partially prepared, and packaged by the flight kitchen. The components are placed in foil containers and stored under refrigeration (32° F. - 37° F.) or immediately quick frozen and stored below 0° F. Foil pack items may be stored for a maximum of 5 days if chilled, and 4 months if frozen. They will not be frozen after having been stored in a chilled state.

BITE-SIZE MEAL. These are concentrated sources of protein, fat, and carbohydrate, prepared, cut into bite-size pieces, wrapped in foil, and frozen until ready to be eaten. Prepared meats should be placed in the freezer while still hot. Storage temperature is -10° F. to 0° F. Stored meat should be used within 10 days after the preparation date. The bite-size meal must be eaten within 5 hours after it is packed.

Inspection of Aircraft

The key to safe flight feeding is stringent sanitation. You must be especially thorough in making inspections of flight foods. Frequently check menus to ensure that dangerous items or "food from home" are not included in flight lunch packages. Weekly inspection of preparation facilities, in-flight kitchens, and preparation areas aboard aircraft is a minimum requirement. Special emphasis must be placed on the following:

PERSONNEL. Must be clean and free from disease

VENTILATION AND TEMPERATURE OF REFRIGERATION. Must be according to regulation.

ICE MACHINE. Must be clean and of potable water quality.

EQUIPMENT. Must be in proper working order, clean, and properly sanitized.

MEALS, MILK, AND ALL STORED FLIGHT FOOD INGREDIENTS. Must be rotated - remember FIFO (first in - first out).

MEDICAL INSPECTION OF FOOD SERVICE SANITATION FACILITIES

Food Service Sanitation Inspection

Food service inspections should be planned and made with the broad objective in mind - you are there to help! Your main concern is to prevent foodborne illness by revealing major discrepancies in the operation. Your effectiveness will depend upon your ability to create and maintain a harmonious, yet firm, relationship with supervisory personnel of the establishments. Every inspection should be viewed as an excellent opportunity for the health education of supervisors and foodhandlers. Don't just point out discrepancies, but add a discussion of possible consequences and reasonable solutions.

The importance of establishing rapport with Food Service supervisors cannot be overemphasized. There will be occasions when you must make comments concerning operations or personnel. The comments must be accepted as constructive criticism; any attitude to the contrary will nullify your effectiveness. A good working relationship will depend to a great extent upon your ability to gain the respect of the Food Service personnel. The basis for this respect will begin with your first contact. Make your first visit a "social" call. Get acquainted with the supervisor; acquaint yourself with the facility. Do not make a report - make a friend.

Conducting an Inspection

During an actual inspection, you must maintain your friendly air, but this is only a small part of gaining the necessary respect. You must display good manners, military formality, and a firm attitude. You must meet or exceed the standards of appearance, health, and personal hygiene required of the foodhandlers. This includes a valid health certificate, clean clothing, clean hands and nails, haircut, and the wearing of a cap during the inspection. Know the job and be able to quickly and correctly answer questions which may arise regarding sanitary foodhandling practices. The Veterinary officer or an NCO should make the actual inspection, and should be assisted by an airman. The OIC and NCOIC should inspect all major food service facilities at least onee a month and every facility each time an "unsatisfactory" report is submitted. As an inspector, you should arrive at the facility with every item necessary to complete the inspection. This includes clipboard, report forms, carbon paper, and pencils. You should also carry a thermometer and any special equipment you will need for the particular facility, e.g., finger culture plates, swab test supplies, ultraviolet light, etc When you arrive, contact the individual in charge. State your name and why you are there, and ask him to accompany you or have someone accompany you. Develop an inspection routine whereby you do not overlook any aspect of the facility; for instance, proceed always in one direction (clockwise or counterclockwise around the facility); do not ramble haphazardly around the building. Point out discrepancies as you note them; ask questions as required, and make appropriate notes concerning comments on why certain conditions may exist. Be sure your comments are valid. Don't nit pick. Remember there is operational "dirt" and there are procedural discrepancies. You must use good judgement in deciding what constitutes a major discrepancy and what is a minor condition. As you make your inspection, set a good example. Wash your hands often if necessary; don't you spread dirt or disease. Be careful how you handle food and utensils. During an inspection, you are the center of attention. You are "under the microscope" and open for criticism if you err. When is the best time to make an inspection? Any time is appropriate. Inspections may be announced or unannounced; each type has its purpose. Inspections times should be staggered to meet all situations, all days, all hours, including preparation times and serving times. The only time to verify that foodhandling techniques and procedures are hygienically adequate and proper is during the preparation and serving periods.

Facility Cleanliness

When you are conducting your inspection, what do you look for? First, look at the walls, ceilings, windows, exhaust ducts, and screens. They should be free from dirt, dust, and grease. The floors of the dining hall should be carefully swept, using a sweeping compound or damp mop after each meal. Remember dry sweeping is prohibited. The floors of the kitchen should be kept clean by washing or mopping with hot soapy water. You should observe the steam tables, drip trays, coffee urns, water fountains, griddles to make sure that they are cleaned after each meal. Kitchen tables used for food preparation will be thoroughly cleaned and sanitized after each use. As you make your inspection you should carefully check all food contact utensils including meat grinders, knives, meat slicers, can openers, pots and pans, and other utensils.

Outside Area of Facility

The outside area of a dining hall is very important, so don't forget to inspect this area. At permanent fixed installations, concrete unscreened garbage stands will be constructed at all facilities serving food. A curb at least 4 inches high should extend around the entire stand, and the stand should have hot and cold running water. The adequate and sanitary disposal of garbage and trash is an important factor in facility cleanliness because this refuse provides food for houseflies, roaches, and rodents, and serves to attract them to the vacinity of food service facilities.

Tests for Cleanliness

A surface free of visible soil may still be capable of spreading disease. Tests have been devised for checking various surfaces to assure you that the surface is indeed clean. These include the finger-plate culture, the rinse test for bottles, the swab test for equipment with large, rough, or irregular surfaces, the contact plate test for small, smooth surface utensils which can be pressed directly on a small surface of culture medium, and the fluorochrome dye test for residual soil film. Other less time-consuming tests are available for quickly determining the efficiency of soil removal techniques. They include the Safranin dye test, salt test, tissue test, rinsability tests, and test for cleanliness of glasses. All these tests are fully explained in Supplemental Study Guide I of this chapter.

Aim to Prevent Foodborne Illness

Your aim is to prevent foodborne illness, and a dirty floor behind a piece of equipment is considerably less of a health hazard than a scrupulously clean foodhandler with boils, URI, or other infectious disease. Let this also be an occasion to double check the food inspection. Inspect food on hand for condition, and make sure it is from an approved source. Before leaving the establishment, critique the inspection with the supervisor. Copies of work order requests or supply requests may be on file, which, if honored, would correct discrepancies. In a report of inspection results, such comments should be made to indicate that efforts have been made to correct unsatisfactory conditions. Supervisors will appreciate such recognition and will generally respond with increased cooperation on future visits.

Reporting

Reports can affect the value of an inspection. An inspection form is not the most effective method of reporting inspection results. Forms may serve well as a checklist to ensure that all aspects of the operation have been observed. A copy of an inspection form (AF Form 977) should be left with the supervisor of the facility to help him in correcting discrepancies. The individual who accompanies you on the inspection should sign your copy; this copy should be maintained in your file. On subsequent visits, it may serve to remind you of conditions which existed at the time the inspection was made. A report should reflect individual effort directed at each establishment; it should not be a check-off inspection sheet which takes the form of a "gig list." In determining results of an inspection, all discrepancies should be considered with regard to their public health significance. When applying this significance in the form of a "satisfactory" or an "unsatisfactory" rating, you must determine whether or not an immediate or potential health hazard exists, or if a discrepancy is due mainly to poor management or careless employees. A point system of scoring is not generally acceptable in determining results. This system too often leads to "unsatisfactory" ratings resulting from a number of minor discrepancies, whereby one major discrepancy may involve an immediate health hazard, yet not carry enough points to rate an establishment unsatisfactory. The Chief of Aerospace Medicine and the DBMS should be kept informed on the conditions of all base food service facilities. You should check with them to find out which reports they wish to see and how frequently. All unsatisfactory reports should be routed through the DBMS.

INSECT AND RODENT CONTROL

As a veterinary technician, your interest in insects and rodents will probably center around those which affect food products. Most of these affect stored food, and are generally called economic pest insects. There are others, of course, which may interest you from a personal standpoint - such as mosquitoes, bedbugs, ticks, and lice - but you generally will not get involved in seeking or controlling these types. Your main function in control of these pests is recognizing signs of their existence, notifying the proper agency, and requesting control measures. Therefore, you must know who is responsible for the various aspects of control. Responsibilities for various aspects of pest control are defined in AFR 91-21, Pest Control, and AFR 161-1, Control of Vector-Borne Diseases. Major commands, the Director of Base Medical Services, and the Base Civil Engineer have been given specific responsibilities under the provisions of these regulations.

1. Major commands (1) ensure that effective preventive and corrective pest control measures are established and accomplished; (2) provide qualified technical supervision for personnel engaged in these operations; (3) provide for training of personnel engaged in pest control; (4) ensure that field supervisors are competent; and (5) issue AF Form 483, Certificate of Competency, to those field supervisors found qualified.

2. The Director of Base Medical Service (DBMS) is responsible for investigation of the identity, source, and prevalence of pests which affect health, comfort, or efficiency of personnel. He (1) recommends personnel protective measures; (2) recommends measures for controlling or preventing breeding of animal reservoirs or vectors of diseases, and evaluates effectiveness of these controls; and (3) provides technical guidance regarding safe use of pesticides.

3. The Base Civil Engineer plans, initiates, and supervises pest control measures. He (1) ensures that pest control personnel are trained and certified, (2) investigates factors relating to economic pests, and (3) inspects and determines the effectiveness and safety of applied control measures.

Economic Pests

Careful periodic inspection of stored food is essential to the control of insect pests. Incoming shipments should be carefully inspected, and samples should be taken from as many different containers as possible. Surface examination will reveal the presence of heavy infestations, while screening of the material is often necessary to detect lighter infestation. Inspection of floors and areas around storage sites will often reveal the presence of live insects which have gotten out of containers, and this is usually an indication of a very heavy infestation. Spilled food that has leaked out of torn bags should also be surveyed, since these spilled products, if not removed, will attract additional insects and the infestation may increase. Loose materials should not be stored in wooden storage bins. Instead, these products should be stored in clean garbage cans with tight-fitting lids, as is the standard procedure in dining halls. Materials which are subject to insect infestation should be stored on pallets of wood, so that no containers are directly on the floor. This allows easy rotating of stock so that older material is used first; otherwise, material which might be highly infested may become a heavy source of infestation, which may spread to the entire warehouse. New stock should not be placed next to a small amount of old stock, since this will lead to immediate infestation of the new material if the old stock is infested. Ventilation is important in the storage of dried foods such as cereals. These foods should be stored so that a space of not less than 3 feet separates each wooden pallet and each stack and the wall. High humidity and warmth will increase the reproduction rate of pest insects. All possible steps should be taken to avoid these conditions. Ventilators should be kept open during periods of dry weather and closed when the humidity is high. Dried foods are not affected by cold temperatures, but the insects which they harbor may be killed or their reproductive rate may be slowed by cold. Thus, it is well to keep warehouses as cold as possible if no goods that may be affected by freezing are stored there. There are those that infest grains and cereals, and those that infest dried fruits and vegetables.

1. Grain and cereal pests

   a. Cadelle beetle - cuts into boxes.

   b. Confused flour beetle - worst pest of prepared cereals.

   c. Indian meal moth - attacks grain, cereal, and crackers.

   d. Rice weevil - most destructive to whole grain and macaroni.

2. Dried fruit and vegetable pests

   a. Cigarette beetle - found in dried fruits or tobacco products

   b. Bean weevil

These are few of the most common species. For more complete information on these and other economic pests, consult a good entomology text, such as Insects, the Yearbook of Agriculture, U.S. Dept of Agriculture, available through the U.S. Government Printing Office; or AFM 85-7, Military Entomology Operational Handbook. In addition to these economic pests, two families of arthropods are of concern because of their attraction to food. They not only are pests, but are likely to spread many types of disease through mechanical transmission. These are the cockroach and the housefly.

COCKROACHES. Cockroaches are one of the oldest group of insects. Specimens have been found which were estimated to be 200 to 500 million years old. These insects are among the most persistent pests of man. They are highly adaptable and can fit themselves into almost any living condition. Cockroaches are frequently found associated with stored foods, or with food that is in actual use. Cockroaches eat a fair amount of such food; they may, in heavy infestations, impart a nauseous odor to it as well. Many disease organisms have been isolated from the feet and legs of cockroaches. Cockroaches damage bookbindings, feeding on the starchy paste material with which such bindings are impregnated. Some damage to clothing may result from the inroads of cockroaches, but this is principally due to feeding on spots of spilled food, rather than on the cloth itself. Some of the common species of cockroaches are shown in figure 1. Cockroaches undergo gradual metamorphosis, and progress through nymphal stages to the adult. There are about 55 species in the United States, but only a few are common pests. All of these having wings in the adult stage, except the female Oriental cockroach. The eggs are laid in capsules. These may be carried about, protruding from the abdomen of the female, or they may be glued to the underside of drawers and cabinets. The eggs in these capsules hatch and very small nymphs emerge. These nymphal forms have the same habits that characterize the adults, except that they do not fly, and of course, cannot produce. The outdoor species of cockroaches normally live in piles of trash, under the bark of trees, and in dark places under houses. The species which are the most importance in buildings are essentially nocturnal, but may be seen during the daylight hours. They frequent various parts of buildings, being limited in most cases to the lower floors or basements where there is adequate moisture. They hide in cracks and crevices, in cabinets and storage areas, and in the spaces between walls. When disturbed, cockroaches will run very rapidly to a shelter area and can disappear very quickly. The simplest method of making inspections for cockroaches is to walk quietly into a kitchen or storage area at night and suddenly flood the area with light. They may also be found by examining cracks and crevices, areas behind door facings, and openings through the walls and steam pipes. Cockroaches usually enter buildings in containers brought in from other areas. They may also enter through cracks in walls, through attics and basements, or along pipes from other buildings which are heavily infested. Inspection of all incoming material will help prevent entry of these pests. However, since egg capsules may be attached to one can in the center of a carton, it is often impossible to make adequate inspections. If all cracks passing through walls or leading to areas behind baseboards and door frames are filled with putty or plaster and if all water, steam, and electrical pipes are given special attention so that there are no openings around them, invasion of cockroaches can

be cut to a minimum. Thorough cleaning to remove food will also help control the numbers present. Cockroaches will not normally stay where there is no suitable hiding place or food. Control of cockroaches in established infestations requires the use of chemicals as well as excellent sanitary practices. Insecticides are applied as liquids or dusts. Residuals are applied to surfaces where roaches will run, and to harborage sites where they remain for longer periods. In some unusual cases, poisoned baits are useful. Aerosols are sometimes used in conjunction with other treatment, but are unsuitable when used alone. Roach control is not obtained with aerosols alone. These cause a rapid knock-down, but the roaches will revive. Aerosols are used to irritate and stimulate roaches. This is an effective survey technique to flush them from hiding. In conjunction with residuals, aerosol may also cause the roaches to run over areas where residuals are present. Aerosols will kill roaches in sewer lines. The confined atmosphere of sewers makes the thermal fogs, mists, and aerosols effective. Residual insecticides in dust and liquid form are used for cockroach control. In some locations, some roaches have developed resistance to certain chemicals. When this occurs, other material must be used. A combination of dust following spray treatment will give much longer and more effective residual control than dust or spray used alone. Roaches have developed a general widespread resistance to the chlorinated hydrocarbon insecticides. Therefore, diazinon, DDVP, or malathion sprays, and diazinon dust are normally the insecticides used.

THE HOUSEFLY - MUSCA DOMESTICA. This common pest is a mechanical transmitter of many filth-borne diseases, such as typhoid, cholera, and dysentery. The adult is dark gray with four black stripes on its thorax. It measures 6 to 7 mm in length. The mouth is not adapted for biting, only for sucking; therefore, all its food must be in liquid form. The female housefly lays about 100 eggs in a mass on vegetable matter, animal manures, garbage, or other refuse. The eggs usually hatch within 24 hours into small white larvae, referred to as maggots. The larval stage lasts from 5 to 8 days and the larva burrows into the ground for a few inches before pupating. The pupa lasts about 5 days, and the adult fly must then make its way up out of the ground in the surface before the wings harden. The entire life cycle may take 8 to 20 days; however, under optimum conditions of temperature and moisture, this period may be even less. There are several means by which flies transmit disease. Examination of the foot of the housefly under a microscope reveals a hairy appendage which is well-suited to picking up material on which the fly walks. Since breeding occurs in various manures, you can see that if human manure is the breeding matter, pathogenic organisms present can be picked up. If a fly then lands on a piece of bread, transfer of the organisms may occur. A second method of disease transmission occurs during feeding. We said before that flies have only sucking mouth parts. They do not feed on solid material. Let's assume a fly lands on a piece of bread. When feeding, the fly forces saliva from its mouth onto the bread. This dissolves the surface of the bread, which can then be sucked up as liquid. Vomitus is also forced up and ejected during this process. Any viable organisms previously ingested by the fly, may be added to the bread. The fly also has a third method by which it may contaminate man's food. It has been proved that enteric diseases taken up by the housefly are still viable when defecated by the same fly. Since the fly defecates at the same time that it feeds, transmission of disease may also occur in this way. Prevention of entry into buildings is one of the best known and widely used controls. Screening over windows and doors is the oldest of these methods. Where screens are not practical or where they are ineffective due to traffic, air screens should be installed. The air current must be of sufficient force to deter flies from entering through the openings. Screening, however, should not be used instead of preventive controls. The best measures for control of houseflies are those which are directed at the cleaning up or removal of breeding sites. Sewage control is usually not a problem on most bases, as far as fly breeding is concerned. However, garbage control is a problem on all airbases. In addition to the final disposal of material, garbage must be properly handled by civil engineering personnel in order to prevent fly breeding. Since, in some areas, flies can breed quite rapidly, garbage from mess halls and quarters areas should be removed at least once weekly. Daily disposal is preferred. Garbage cans should be kept clean. This will help considerably in the control of flies. Spilled garbage, particularly liquid and semiliquid wastes will soak into the ground and allow breeding around garbage cans. Cans should be kept closed with a tight-fitting lid to prevent access of flies. Any normal size issue screening will prevent the entrance of houseflies, but these

screens must be kept in good condition and must be tightfitting, and screen doors should swing outward, to push away flies which may be clinging to them. An inward-swinging screen door may admit flies that are resting on it each time it is opened. In many cases, the source of houseflies is not located on the base, but on nearby farms and in open privies. Control of off-base breeding must be coordinated with the local Health Department, since the Air Force has no authority on private property. The adult fly, after emerging from the pupa, must force its way upward through the surface of the breeding material. This fact can be used in some cases to effect a measure of control. In areas where red clay soil predominates, sprinkling of the earth in the morning and then allowing it to harden under a hot sun has been used as a method of fly control. Similarly, the soaking of soil around privies with a chemical insecticide may be of some help, but the addition of insecticides to the contents of the privy is not recommended. Chemical insecticides may reduce the natural bacterial activity which occurs in a privy. Houseflies are attracted primarily to vertical surfaces such as light cords, and light pull chains. They also rest on walls and on the ceiling. This characteristic makes possible control through use of fly cords, fly tapes, and residual sprays. However, fly tapes and cords are discouraged, because if proper steps are taken to prevent breeding, fly tapes and cords will be unnecessary. One pair of houseflies in the early spring, could produce billions of flies by late fall, if all of their young lived. It is, therefore, important to kill as many as possible early in the season. A good early-season fly control program will result in very few lives all year long. In discussing the importance of a fly-control program with troops, effective cooperation can be obtained if the filthy habits of the fly are stressed. A good point to make is that any time a fly is seen on food it is well to remember where this fly probably fed last. This usually results in an increased demand for fly swatters at supply, and incidentally, the fly swatter is still an excellent tool for individual fly control.

RODENTS.* Rats and mice have followed man to most of the areas he has settled. Man's indifference and carelessness in handling foodstuff and refuse have fostered populations of rats and mice in such proximity to his home and work that they are called "domestic" rodents. As a result of this relationship, man suffers from rat bites and rodent-borne diseases. Rodents are reservoirs for diseases that have killed millions of people. These include murine typus fever, plague, leptospirosis (Weil's disease), rat-bite fever, salmonellosis, and rickettsialpox. Rats and mice common in the United States are shown and compared in figure 2. Refer to this figure as you read the following descriptions of rats and mice. The Norway rat (Rattus norvegicus) is predominantly a burrowing rodent. It is the most common and largest of the domestic rats. It is found generally throughout the United States and the temperate regions of the world. Some of the characteristics of this rodent are:

1. Harborage. Ground level, burrows in ground and under foundations of buildings and in rubbish dumps.

2. Range. Frequently 100 to 150 feet.

3. Food and water. Omnivorous; cereal grains preferred; mouse is a nibbler, daily requirement 1/10 ounce dry food, requiring little water (1/20 ounce per drink).

Rats and mice are habitually nocturnal and secretive. They are rarely seen except when heavy infestations are encountered. Therefore, it is necessary to interpret signs of their activities properly in order to plan control work. These signs are found in secluded places such as along walls, under pipes or rubbish and behind or under boxes, boards, and thick vegetation. From rat signs, one can tell the species concerned and whether a rodent infestation is current or old, heavy or light. Feces, if fresh, will be

*The material in this section is adapted from Control of Domestic Rats and Mice, published by the USPHS, Department of Health, Education & Welfare; Atlanta, Ga.

soft, shiny, and dark. In a few days they become dry and hard. Old droppings are dull and grayish. They crumble when pressed with a stick. Rats habitually use the same runways between food, water and harborage. Because of the keenly developed sense of touch in their whiskers and in specialized hairs along the body, rats prefer continual body contact with at least one vertical surface, such as a fence or wall. Outdoors these runways are narrow pathways of beaten earth swept clear of debris. Indoors, greasy runways are found along walls, steps, and rafters. Undisturbed cobwebs and dust in a runway indicate that the runway is not in use. Along regularly traveled runways a dark, greasy mark usually forms from contact with the rodent's body. Fresh marks are soft and greasy. They will smear if rubbed. With age the grease dries, gathers dust, and will flake off when scratched with a fingernail. Norway rat rubmarks are most commonly found along walls near ground or floor level. Roof rat rubmarks are most commonly located overhead as swing marks beneath beams or rafters where they connect to the walls. Mice seldom leave detectable rubmarks. The Norway rat prefers burrows for nesting and harborage; the roof rat burrows only occasionally. Burrows are found in earth banks, along walls, under rubbish, under concrete slabs, and in similar places. If being used, the burrow entrance will be free of cobwebs and dust. Fresh rubmarks on hard-packed soil at the opening indicate a well-established and presently used burrow. Fresh food fragments or freshly removed earth at the burrow entrances also indicate current use by rats. Rats must gnaw daily to keep their teeth short enough to use. They gnaw to gain entrance to obtain food. When fresh, gnawings are light in color and show distinct teeth marks. Small chips of wood or other materials indicate recent gnawing. With age, the wood around gnawed holes becomes dark and smooth from frequent contact with the rodent's body. Fresh tracks appear sharp and distinct. Old tracks are covered with dust and are less distinct. The tracks of the 5-toed rear paws are more commonly observed than are the 4-toed front paws, but both may be present. Smooth tracking patches of any dust material such as flour or talc, placed along runways are of value in checking for rodent activity. To see tracks in dust, hold a flashlight at an angle so that the tracks will cast distinct shadows. The best control for rodents, as for insects, is prevention. Physical measures and sanitation practices are foremost in this area. The best preventive measures include:

1. Prevention of entry into buildings.

2. Frequent and thorough cleanup of trash and debris.

3. Proper waste disposal.

4. Proper food storage.

5. Elimination of food sources.

6. Elimination of harborage.

Floors should be swept frequently to remove rodent food and to permit ready detection of fresh rodent signs. A white band, 6 inches wide, painted along the floor next to walls in food-handling locations speeds discovery of droppings, tracks, and other signs that indicate the presence of rodents. Thorough inspections should be regularly scheduled to detect any new evidence of rodent infestation. Effective and permanent control of rats and mice can be attained only through a continuous sanitation program. Established rodent populations can be eliminated by combining the sanitation methods with a killing program. Killing methods most effective:

1. Before sanitation or cleanup programs are begun. This will prevent mass movement and spread of rodents.

2. After dusting with 10 percent DDT for flea control. This is to suppress plague and murine typhus by reducing rodent populations. If rodents are killed and fleas are not, fleas will leave the dead rodents and may cause widespread disease outbreaks.

3. After vent stoppage, work to eradicate rodents in buildings.

Rat killing as well as insect killing, without good sanitation, is ineffective for several reasons. Insects and rodents rapidly regain the original population level through their high birth rate and survival of young. The cost of labor and materials in a continuous killing program is high. Bait-shyness and insecticide resistance may develop from continued use of most poisons. For these reasons, it is a waste of your time and effort to have a killing program which is not supplemented with a sanitation program.

ACTION IN DISEASE OUTBREAKS

The Director of Base Medical Services and his staff will investigate outbreaks of foodborne disease. The determination of the exact etiological agent responsible for these outbreaks depends upon the early recognition of the first few cases. This does not necessarily indicate a food poisoning outbreak; it does indicate a need for an immediate investigation. Each medical facility should have a notification plan which is implemented whenever three individuals per thousand strength or three per thousand diners in a mess hall report to the medical facility complaining of gastric distress, nausea, vomiting, or diarrhea within an 8-hour period. Speed is essential to an effective food poisoning investigation! Your objective is to determine the cause of the outbreak and to break the chain of infection. This will prevent further cases resulting from the immediate offending food and will provide a basis for educating those involved as to measures which will prevent future incidents. There is also a possibility that biological warfare has been attempted! Early recognition of this could be vital to the defense of the nation. There are other reasons for immediate response. Delay may allow patients to forget important information; conditions may change rapidly; or the infective or toxic food may be thrown away -- either purposely or inadvertently. Any of these or other factors may result in erroneous or inconclusive data. But remember -- don't sacrifice accuracy for the sake of speed. Therefore, you should plan ahead. A standing operating procedures must be developed by each DBMS. After the decision has been made that an outbreak of food poisoning or food infection is occurring, the notification plan should be initiated. Let us assume that there were 100 persons at a picnic. The group consisted of 50 couples, ranging in age from 21 to 40. At the picnic, the following menu was available; cold chicken, sliced ham, potato salad, baked beans, jello, cola, beer, coffee, rolls, and butter. About three or four hours after eating, people from the picnic began to appear at the hospital complaining of diarrhea, cramps, nausea, and vomiting. In order to plan a study of the cause of the outbreak, you are asked to interview the people involved and to record the results of the interviews. What information will you want to obtain? How will you tabulate the data so that it may be easily studied? First, you must decide what questions you want answered; then formulate a group of questions to ask each individual. The questions you want answered are: (1) What organism probably caused the outbreak? (2) What food or combination of foods contained the organism? (3) Who prepared the food that contained the organism? (4) What caused the food to become contaminated? (5) How could the outbreak have been prevented? Whom should you interview? In order to answer the necessary questions quickly, only the sick persons would be readily available; however, a representative number of the well people should also be interviewed. To be more thorough, if time permits, all 100 people who attended the picnic should be interviewed. What questions are necessary to establish the identity of the organism? You know from previous study, that organisms which cause foodborne illness poisoning react in certain predictable ways. i.e., time between ingestion of food and onset of symptoms, and characteristic symptoms of various organisms. From this, we can determine that we need to know: (1) what symptoms each person displayed, (2) which meal caused the outbreak and the time the meal was consumed, and 3) what time the symptoms began. To determine what food or drink contained the organism, you must try to find the common denominator -- the one meal which was common to all the patients, and the one food or beverage from that meal which was consumed by all those who became ill. So you list the items consumed by each individual at each meal for the past 3 days. Now look at figure 3. Here you have a reproduction of AF Form 431, "Food Poisoning Outbreak -- Individual Case History," which is especially designed for obtaining data on individuals involved in food poisoning outbreaks. One of these forms will be filled

out on each individual concerned. Note that the form has ample space to record physical symptoms with their onset and duration; and for a record of the foodstuffs consumed for the last 3 days (don't forget snacks), along with the date, hour, and place. The last entry in figure 3 should list some of the articles of food that were served at the "picnic." After the individuals involved have been interviewed and the results have been recorded on AF Form 431, you would want an overall picture of how many people consumed each food item and the incidence of illness in relation to each food item. If you look at figures 4 and 5, there is a Department of Health, Education and Welfare form HSM 4.245 designed for recording your data analysis. This form will be filled out completely with special emphasis on Section 7 (food-specific attack rates) to help determine the suspected food item. Further complete and distribute this form in accordance with AFM 163-8. For the third step in your data collecting, you will need to get a tabular picture of what time the symptoms of the illness began. AF Form 432 is used for this purpose, and it appears as figure 6. One of these forms is used for each outbreak of foodborne illness. You can see that it is well designed for your use. All you have to do is to go back through the individual case histories and enter your calculations in the right-hand column of the form. Now that you have stated the problem, collected the pertinent facts, and tabulated or charted the data, it is time to solve the problem: why did it happen and what must be done to prevent its recurrence? If you analyze the data collected, you should get a partial answer, at least. You know that staphylococcus organisms create toxins that have an average incubation period of 4 to 6 hours, therefore, you have a definite clue to the causative agent in our food-poisoning outbreak. Knowing also that staphylococcus grows readily in salads, pastries, custards, sliced meat, ham, etc., we also have some suspected carriers -- Ham? Chicken? Potato salad? The table of foods (figure 4) consumed by the affected persons may supply the exact answer, or it could show as many as two or three, or more, likely suspects. The mathematical approach is the method most likely to give the quickest correct solution. After determining the number and percent of people involved in the "Good-Specific Attack Rates" (figure 4), subtract the percent of incidence eating. Put this difference in the margin opposite the food involved. The food which shows the largest percentage difference is usually the probable cause. In this case, everybody ate potato salad but not everybody got sick. Everybody who got sick ate jello, but jello is not a probable medium for bacterial growth. The most likely suspect was the sliced ham. But two people ate sliced ham and didn't get sick. This is not unexpected. Those who were exposed and weren't affected may have been resistant or didn't get as large a dose of toxin as the ones who became ill or were made psychologically ill; or some data may be incorrect due to faulty memory concerning foods actually eaten. There could be other factors. So, from analysis of our data we can make the assumption that the causative agent was staphylococcus enterotoxin. This was based on the symptom onset data that was shown in figure 3. The probable carrier was sliced ham. In order to confirm that the sliced ham was the carrier, laboratory bacteriological analysis should be performed on all the items from the picnic, if available. To save time, however, you must assume that you have drawn the correct conclusion and look for the source and method of contamination. By questioning the planner of the picnic, you can find out who prepared and delivered the sliced ham. And by careful, diplomatic investigation you may be able to discover the reason for the introduction and growth of staphylococcus toxin in the ham. In this part of the investigation, tact and diplomacy are vital factors in producing true facts. Nobody likes to admit that through carelessness or oversight they were responsible for an outbreak of illness. From your data analysis, you will have information that will aid in educating people to the dangers of food illness to the extent that future outbreaks will not happen. If a situation such as our picnic should occur as a result of a meal served in a dining hall, additional methods are required to complete the investigation. These include obtaining a menu, a thorough inspection of the dining hall, interviewing and inspecting personnel who work in the establishment, and obtaining food samples, if available. From this discussion, we can conclude that outbreaks of foodborne illness can be costly in man-hours lost, hospitalization costs, human suffering, and even death. In most instances these can be prevented.

SUPPLEMENTAL STUDY GUIDE I

TESTS FOR CLEANLINESS OF SURFACES. Having, hopefully, now achieved a thoroughly safe surface for food contact, the following tests can help assure you that the surface is indeed clean.

1. Finger Plate Culture. This check for adequate hygiene of food handlers is discussed in AFM 163-8. Remember that a positive result for the presence of Escherichia coli is not just indicative of handwashing after using a latrine but will indicate contamination by any item in or on which feces may have been present, i.e., garbage, shoes, some raw meats, etc. Washing hands should also be practiced after handling any of these, however.

2. The Rinse Test

a. Materials needed:

(1) Transfer pipettes, sterile - delivery 10 ml.

(2) Dilution pipettes, sterile - delivery 1.1 ml.

(3) Petri dishes, sterile.

(4) Plate Count Agar, omit addition of skim milk.

(5) Tap or buffered distilled water, nontoxic, sterile (tubed in 20 ml. amounts).

(6) Sodium thiosulfate solution, approximately 0.1N which should be incorporated in buffered rinse medium if a chlorine disinfectant was used on item to be tested. Not necessary if nutrient broth is used.

(7) Hypodermic syringe and needle, sterile, delivery 20 ml. (optional).

b. Procedure

(1) Introduce 20 ml. of sterile tap or buffered distilled water into bottle to be tested.

(2) Cap bottle aseptically with sterile cap.

(3) Grasp bottle by neck and while holding upright, swing it 25 times in a small circle to rinse bottom thoroughly.

(4) Follow by holding bottle horizontally and vigorously shake lengthwise 25 times, each shake being a to and return thrust of almost 8 inches. Turn bottle slightly at end of each shake and make eight complete rotations of bottle during shaking operation to rinse sidewalls thoroughly.

(5) Plate immediately, if rinse operation is performed in the laboratory. If samples are to be transferred to a laboratory, transfer rinse solution to sterile containers aseptically and keep at 32° to 40° F. until plated.

(6) Pour appropriate controls (agar, petri dish, pipette and rinse solution).

c. Plating

(1) If contamination is considered to be small:

(a) Distribute 10 ml. of the 20 ml. used for the rinse test about equally among three sterile petri dishes and incubate for 48 hours at 32° C. or 35° C.

(b) To obtain total count, multiply the sum of the number of colonies on the three plates receiving 10 ml. of rinse solution by 2 which will give estimated number of colonies per bottle.

(2) If contamination is considered to be great:

(a) Transfer 1 ml. of rinse solution to each of 2 petri dishes.

(b) To obtain total count, multiply the average number of colonies on the plates by 20 which will give the estimated number of colonies per bottle.

(3) If desired, with contamination considered great enough to result in more than 300 colonies per plate, 0.1 and 1.0 ml. portions of the rinse solution may be plated directly. In such instances, if the 30-300 colony range is obtained on the 0.1 ml. plate, multiply the count by 200. If the plate counted is the 1.0 ml. plating, then the count times 20 will result in the estimated number of colonies per bottle.

(4) When information on high count bottles is required, dilutions may be made of the rinse solution. Here the count per plate is multiplied by the dilution followed by multiplication by 20, to obtain estimated number of colonies per bottle.

d. Important Consideration

(1) If chlorine or iodine disinfection of bottles is practiced, a neutralizer such as sodium thiosulfate, 0.1N, contained in the rinse solution should be used in order to prevent the continued germicidal action of residual chlorine in the test bottle on the organisms rinsed off the container by the rinse solution, thereby giving a false indication of the bacterial condition of the container. Not necessary if nutrient broth or skimmed milk is used as rinse medium.

(2) If quaternary disinfection is practiced, an inactivator such as sodium napthuride or Tamol N should be used in the rinse solution in a 200 ppm concentration followed by plating the test rinse solution in tryptose glucose extract Tween (1%) - Asolectin Agar (100 ppm) in order to minimize or eliminate bacterio-static carry-over of quaternary.

e. Interpretation of Results

Colony estimates by the agar plate method (Rinse Test) not exceeding:

per quart bottle	1000
per pint bottle	500
per 1/2 pint bottle	250

are considered satisfactory.

These standards are derived on an allowable basis of one colony per 1 ml. capacity of the container and are applicable to all rinse test methods involving the rinsing of closed containers.

3. The Swab Test

The swab test is adaptable to equipment where size and irregularity of surface will not permit satisfactory use of either rinse or contact plate methods. However, it may be applied to milk cans and other similar equipment. It is the method generally used in determining food utensil sanitization.

a. Materials needed

(1) Sterile Petri dishes

(2) Sterile 1 ml. pipettes

(3) Plate count agar (omit skim milk)

(4) Sterile forceps or scissors

(5) Sterile cotton swabs (nonabsorbent cotton) on standard wooden applicator sticks (or sterile alginate swabs) in cotton plugged test tubes.

(6) Sterile containers, screw cap swab bottles 23X70 mm. or 16X100 mm. with 4 ml. buffered distilled water.

(7) Buffered distilled water (See "Standard Methods for Examination of Dairy Products"

(If chlorine, iodine or quaternary disinfection is practiced, use appropriate inactivator and proceed in accordance with instructions under rinse test section above.)

b. Collecting Samples

(1) Utensils to be examined shall include at least glasses, cups, and spoons, and four of each should be selected at random from the shelves or other places where clean utensils are stored.

(2) In direct checks of dishwashing methods, select utensils from those recently washed. Prevent contamination by handling during sampling.

(3) Use one swab for each group of four similar utensils.

c. Swabbing Procedure

(1) Dip a sterile swab in dilution water and squeeze it against the inside of the container so as to remove excess water, leaving the swab moist, but not wet.

(2) Rub the swab slowly and firmly three times over the significant surfaces of four utensils, reversing the direction each time. Significant surfaces of utensils consist of:

(a) The upper 1/2 inch of the inner and outer rims of cups and glasses.

(b) Entire inner and outer surfaces of the bowls of spoons.

(c) Entire inner and outer surfaces of the tines of forks.

(d) Inner surfaces of plates - swab three times reversing the direction of each stroke. Swab across each of two diameters at right angles to each other.

(e) Inner surfaces of bowls - swab three times reversing the direction of each stroke around the inner surface at a level at which the swab will hug the surface of the bowl about halfway between bottom of bowl and rim.

(3) After swabbing each individual similar utensil, return the swab to the container of dilution water, rotate (whip rinse) the swab in the dilution water and press out the excess water against the inside of the container before swabbing the next of the four utensils in the group.

(4) On completion of the swabbing of the group of utensils, break off the swab in the container of dilution water under aseptic conditions. Use a new swab container for the next group of utensils.

(5) Keep containers iced while in transit to the laboratory. Plate the dilution water samples preferably within 4 hours of swabbing, but when this cannot be done, samples must be properly refrigerated and analyzed within 24 hours of swabbing.

a. Plating Procedure

(1) Shake the swab container rapidly, making 50 round-trip excursions of 4-6 inches with the container in one hand, striking the palm of the other hand at the end of each cycle and completing the whole in about 10 seconds.

NOTE: Groups of samples may be shaken in test tube holding blocks with similar stroke, speed and abrupt ending of strokes. Shaking machines may be used for the time interval found to disintegrate the cotton swab in a manner equivalent to the prescribed hand method.

(2) Transfer 1 ml. of the dilution water to a sterile petri dish.

(3) Add approximately 10 ml. of melted standard plate count agar (without skim milk), mix and incubate for 48 hours at 32° C. or 35° C. and count as in making standard plate count.

(4) Make appropriate controls (agar, petri dish, dilution water, pipette).

(5) Report the count as the average plate count of organisms removed per utensil surface examined.

Example: 4 glasses swabbed

1 ml. of the 4 ml. dilution water plated.

60 colonies are counted after incubation.

Recorded average plate count per glass surface as 60.

(6) If, under the same conditions, the 4 ml. are plated by distributing equal portions into each of three petri dishes, the sum of the counts on each plate divided by 4 would give the average plate count per glass surface.

e. Interpretation. The most commonly accepted standard is not more than 50 colonies per utensil.

The most commonly accepted basis for this is 50 organisms per 8 square inches swabbed, or 6.25 organisms per square inch.

4. Contact Plate Test

a. Materials Needed

(1) Sterile disposable contact plates, often called "Rodac" plates, available from Falcon Plastics, 1950 Williams Dr., Oxnard, California 93030, and some other laboratory equipment suppliers. This plate differs from petri plates in shape.

(2) Transfer pipettes, sterile, 10 ml.

(3) Plate count agar, omit addition of milk.

b. Procedure

(1) Carefully and aseptically introduce enough sterile agar (usually 15.7 ml.) into the sterile plate so the agar meniscus is slightly raised above the plate rim. Allow to solidify without moving.

(2) To test a surface, remove the lid, invert plate and gently press the raised agar surface onto test site. Carefully lift the plate after several seconds and replace the lid.

(3) Incubate, normally for 48 hours at 32° C. or 35° C.

c. Interpretation of Results

(1) Number of colonies gives a direct count of the surface area tested for the 4 square inches of the plate surface.

(2) Divide count by four and apply available standards for count per square inch.

5. Other "seeing is believing" bacteriological tests are available in which the actual spoon, glass, etc. are incubated within the media allowing the bacteria to grow "in situ." For a discussion of these tests, see the Journal of Environmental Health, Nov-Dec 1963, Volume 26, No. 3, pp. 187-197.

6. Ultraviolet Test for Residual Soil Film

a. This is a very simple and accurate test requiring only a fluorochrome dye (any soluble color) and an ultraviolet light (Woods Lamp).

b. When surfaces, whether dishes or steel tables, are exposed to a solution containing dye, the fluorochrome adsorbs to any porous surface, usually the soil, and then fluoresces under ultraviolet light.

c. Mix a 1:1000 solution of dye in water. The dye may be mixed directly into the wash tank of a dishwashing machine to check its efficiency, or may be mixed in a container and the small items to be tested dipped therein, or the solution may be used as a spray for surfaces of large items.

d. Procedure

(1) Whether dipped, sprayed, or washed, the test items should be exposed to the dye solution for 30 seconds.

(2) Then rinse well in running cold or warm water for several minutes. A machine's rinse cycle will do this automatically.

(3) Examine under ultraviolet light in dark or semi-dark room.

e. Interpretation

(1) Large spots usually indicate poor washing.

(2) Small spots usually indicate poor rinsing.

(3) Diffuse fluorescence indicates carry-over of dye into rinse tank (which is a discrepancy within the machine), a long standing buildup of grime or minerals due to poor washing, or extremely inadequate washing.

f. Discussion

(1) If you have never performed this test it would be wise to have a dry run using a spotlessly clean item for a comparison.

(2) Remember porous surfaces such as aluminum, crazed china, dull plastics, etc., will pick up dye.

(3) This is an excellent test for all utensils but especially sieves, colanders, beaters, grinders, pitchers, etc.

7. Safranin Dye Test

a. Make a powder mixture of 85 percent by weight talc (U.S.P., not face powder) and 15 percent by weight safranin and place in a salt shaker.

b. Dust onto dry test surfaces from a height of 2 inches.

c. Rinse the surface with cold water until no red color is rinsing off.

d. Organic matter, mainly grease, will be stained a deep red due to the adsorption of the talc onto the surface, but water spots will not be affected.

8. Salt Test: Wet a dish in cool water and hold it so water can drain off for several seconds. Then sprinkle the surface with ordinary table salt. The surface of a clean dish will be evenly and completely wet with salt adhering overall. Areas with no salt adhering are areas of "water break" due to a grease film which the water was not able to "wet".

9. Tests for Clean Glasses

a. Fill a glass with regular soda water. Any evidence of bubbles clinging to the sides or bottom indicates inadequate cleaning. A clean glass will show very little or no bubbles adhering anywhere. Try it sometime. Pour the soda from a clean glass into a dirty glass and observe bubbles reappear from what had looked like uncharged water.

b. Partially fill a glass with water and observe the meniscus. If it is perfectly smooth and even the glass is clean; if it is slightly wavy the glass is dirty. Pour the water out and water drops will cling to the dirty glass but not the clean one.

c. Tissue Test: Rub surface to be tested vigorously with white tissue, filter cloth, or cheese cloth and note whether the tissue remains spotlessly clean.

d. Rinseability Tests (to see if all detergent was rinsed off):

(1) Add two drops isopropyl or methyl alcohol to surface and allow it to evaporate. If no white deposit forms, the rinsing was good.

(2) Wet the surface to be tested with a small amount of distilled water and drop onto it one drop of phenophthalein. A change to any shade of red indicates alkalinity and hence poor removal of the detergent.

e. Tests for Evaluation of Dishwashing Machines

(1) The following steps should be followed to periodically determine the efficiency of machine operation:

(a) Determine that the dishes are clean (see previous tests).

(b) Determine, using a calibrated maximum-registering mercury thermometer, the temperature of the water in the wash and rinse of a multiple tank machine by

immersion in the water in the respective tank(s). Either recalibrate the thermometer provided on the machine or record the corrective differential for the thermometer in an appropriate place.

The temperature of the water is extremely significant in providing effective sanitizing of the dishes. Wash water temperatures less than those prescribed will result in an ineffective sanitization of dishes even when the final rinse temperature is properly maintained. Sanitization results from the cumulative temperature effects of wash, power rinse if applicable, and final rinse waters.

(c) Remove from the inlet manifold the thermometer or sensing bulb used to indicate the temperature of the final rinse water. Check the removed thermometer or sensing element against a calibrated maximum registering mercury thermometer by immersing both in a container (glass, pan or can) of hot water. The calibration should be conducted at approximately the use range (180° F.). Recalibrate the machine thermometer if possible or record differential correction.

NOTE: The sensing bulbs in certain machines are of such construction or so located that they cannot feasibly be removed. There are three accurate alternatives which will permit the determination of the final rinse water temperature in such instances. They are as follows:

1. The access plug located in the final rinse line which permits determination of the flow pressure may be removed and a maximum registering thermometer inserted in the opening by means of a compression type connector. Operate the final rinse and recalibrate the machine or record the differential correction.

2. Using a modified version of a standard capillary tube, dial type thermometer, (such as U.S. Gauge, Design 8000, range 100° to 220° F., with a preformed, coiled, test bulb, 3 foot system or capillary, available from: U.S. Gauge, Division of Ametack Industries, Sellersville, Pa.) place the bulb parallel to the direction of the rinse jets and 1/2 inch from the jets. Operate the final rinse from 10 to 15 seconds, record the temperature on both the calibrated test thermometer and the final rinse thermometer of the machine. Recalibrate the machine thermometer, or record the differential correction. A 5° temperature variation may be expected between the water temperature at the water location on the machine and the water at the rinse jet, depending on the design and construction of the individual machine.

3. Attach the "leads" (sensitive elements) of an electronic pyrometer to dishes and allow them to complete the dishwashing cycle recording the temperatures for each. If the dish surface temperature reaches 170° F., the final rinse temperature is satisfactory.

(d) Check that all spray nozzles in the wash, power rinse and final rinse spray arms are open and unobstructed.

(e) Determine that the flow pressure of the final rinse supply line is 20 psi (15-30 psi range is permissible).

(f) Operate the machine and determine the wash, power rinse and final rinse temperatures (corrected), and time periods.

(g) If the above six steps are taken for the wash, power rinse and final rinse cycles, and if temperatures and time periods are being observed, it can then be reasonably assumed that adequate sanitization of dishes is being accomplished.

(2) By allowing a maximum-registering thermometer to pass through a machine, you will receive a good "ball park" figure on which to base judgments. Do not rely on its reading as entirely accurate since most of these thermometers' response time is too slow to

positively show the highest temperature experienced. Follow the steps in paragraph 5, 1, (1)(c)1 and 2 for accuracy. Remember the dish surface temperature should reach 170° F. but the water within the rinse spray arm should be a minimum of 180° F. to assure the surface temperature of 170° F.

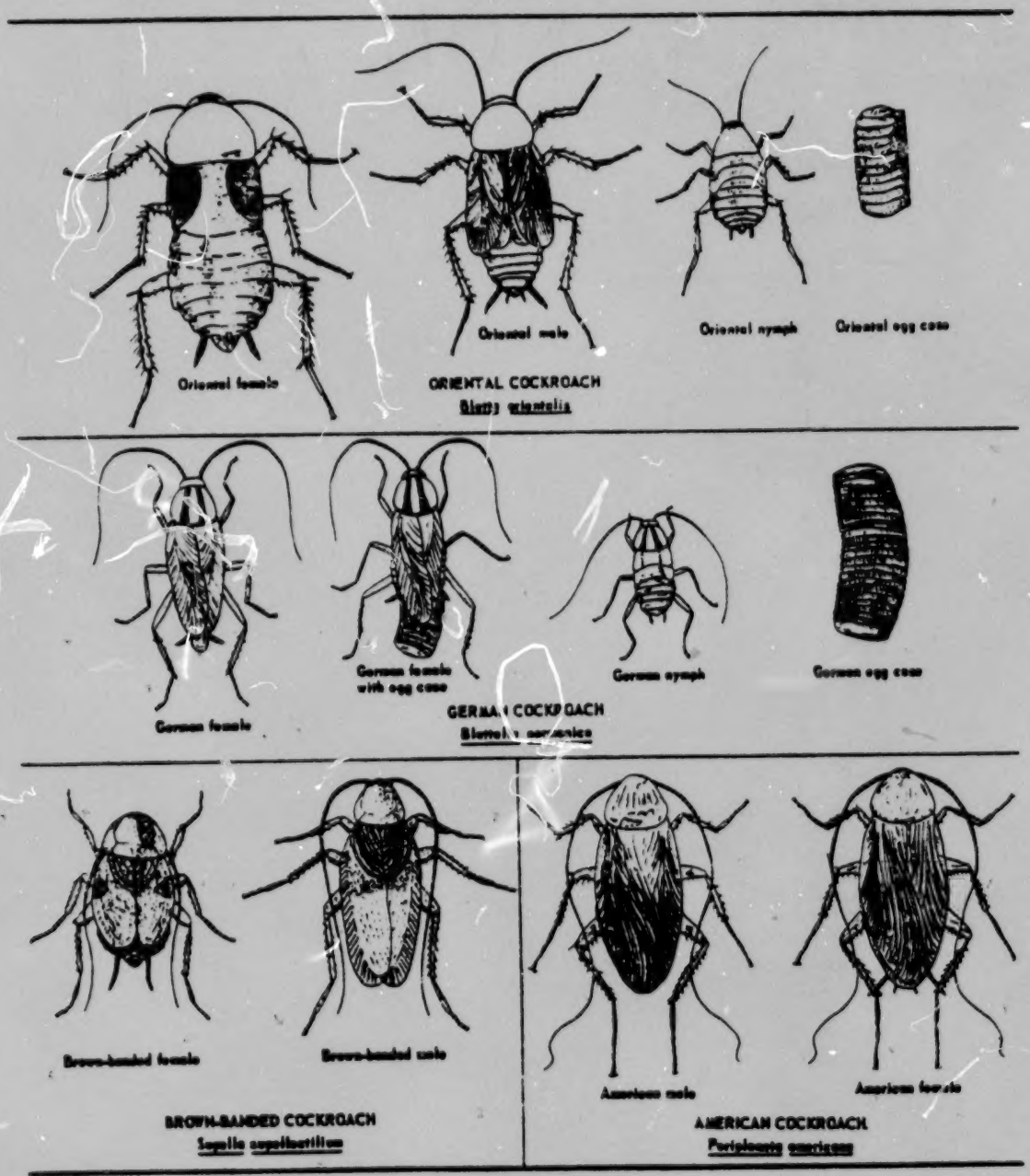


Figure 1 - Common Species of Cockroaches

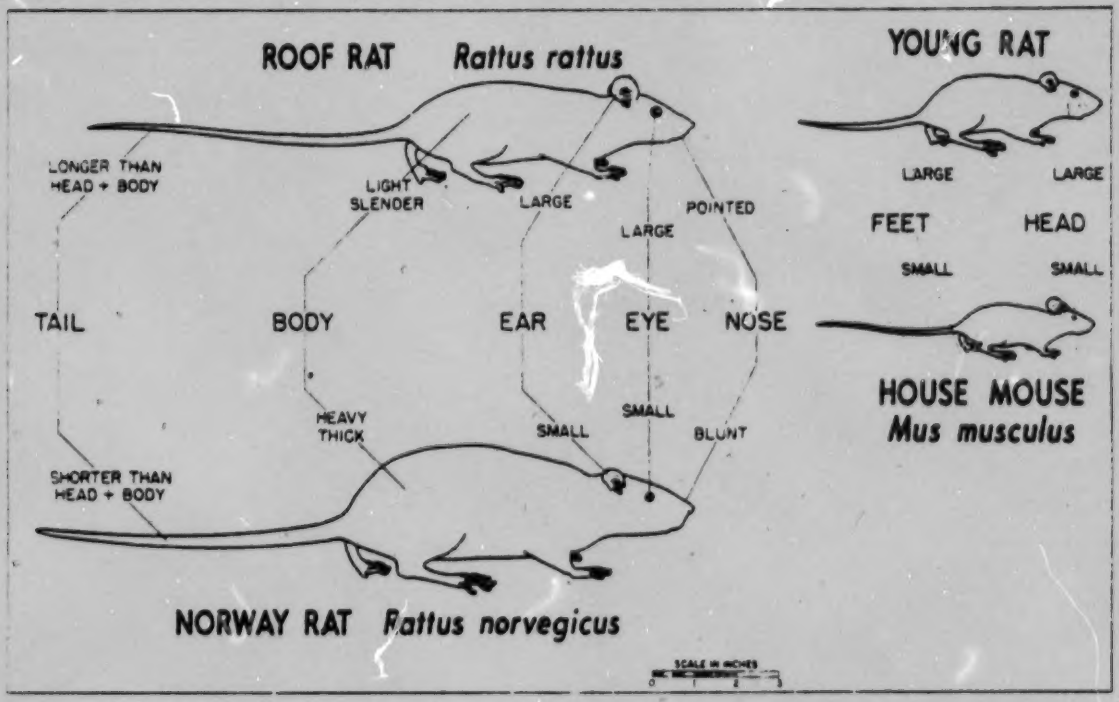


Figure 2 - Common Rodents

FOOD POISONING OUTBREAK - INDIVIDUAL CASE HISTORY		Case No. 6
Last Name - First Name - Middle Initial Brown, Robert O. TSgt		Quarters 896
SYMPTOMATOLOGY		
Onset of Symptoms (Date and hour) 1730 hrs. 3 July 1971	Duration of Symptons Aprx 8 hrs.	Fever No
Nausea, Vom ting (Frequency) Vomiting - 2/hr.	Diarrhea (No. of stools, water, bloody, mucous, pus) Water - 3-4/hr.	
Abdominal D scomfort (Cramps, tenesmus) Extensive cramps	Other (Specify) Myalgia	
Laboratory Specimens from this Patient Vomitus		

EPIDEMIOLOGY (Food and drink 3 days prior to onset)

Occasion	Date July	Hour	Place	Articles of food and drink
Breakfast	2	0700	NCO Club	Eggs, toast, bacon, grits, coffee & orange juice
Lunch	2	1200	BX Cafeteria	Cream chowder, crackers, toss salad, milk
Dinner	2	1730	NCO Club	Fried steak, mashed potatoes, gravy, bread, tea
Other	2	2130	Drive-in Snack Bar	Hamburger, french fries, soft drink
Breakfast	3	0700	NCO Club	Eggs, toast, ham, grits, coffee & orange juice
Lunch	3	1200	BX Cafeteria	Cheese sandwich, toss salad, chocolate milk shake
Dinner	3	1730	NCO Club	Meatballs and spaghetti, bread, toss salad, beer
Other	3	2100	BX Snack Bar	Pizza and beer
Breakfast	4	0900	BX Snack Bar	Toast and coffee
Lunch	4	1300	Squadron Picnic	Cold chicken, sliced ham, potato salad, baked beans, jello, beer
Dinner	---	----	---	----
Other	---	----	---	----

Additional Information (Others accompanying patient at any of the above meals, with or without illness, etc.)

Food at picnic appeared good and tasted good.

Medical Fac lity	Signature of person completing form
Blank AFB, Texas	Robert O. Brown

AF Form 431 Sep 60

Figure 3

Data Collecting on AF Form 431, Food Poisoning Outbreak

10

FORM APPROVED
BUDGET BUREAU NO. 68-R1034

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
Health Services and Mental Health Administration
NATIONAL COMMUNICABLE DISEASE CENTER
EPIDEMIOLOGY PROGRAM
ATLANTA, GEORGIA 30333

INVESTIGATION OF A FOODBORNE OUTBREAK

1. Where did the outbreak occur?
State: Texas (1,2) City or Town: Blank AFB County: Wild

2. Date of outbreak: (Date of onset 1st case)
4 July 1971 (3-8)

3. Indicate actual (a) or estimated (e) numbers
Persons exposed: 100 (9-11)
Persons ill: 46 (12-14)
Hospitalized: 0 (15-16)
Fatal cases: 0 (17)

4. History of Exposed Persons
No. histories obtained: 75 (18-20)
No. persons with symptoms: 46 (21-23)
Nausea: 10 (24-26) Diarrhea: 37 (33-35)
Vomiting: 3 (27-29) Fever: 11 (36-38)
Cramps: 46 (30-32) Other, specify: Headache 6 (39)

5. Incubation period (hours):
Shortest: 1 (40-42) Longest: 10 (43-45)
Approx. for majority: 4 (46-48)

6. Duration of illness (hours):
Shortest: 4 (49-51) Longest: 18 (52-54)
Approx. for majority: 10 (55-57)

7. Food-specific attack rates: (58)

Food Items Served	Number of persons who ATE specified food				Number who did NOT eat specified food			
	Ill	Not Ill	Total	Percent Ill	Ill	Not Ill	Total	Percent Ill
Cold chicken	30	11	41	73	23	11	34	69
Sliced ham	43	11	54	80	3	18	21	14
Potato salad	29	17	46	63	17	12	29	59
Baked beans	26	17	43	60	20	12	32	62
Jello	4	2	6	67	42	27	69	61
Cola	23	14	37	62	23	14	37	62
Beer	13	11	24	54	33	18	51	65
Coffee	19	12	31	61	27	17	44	61
Rolls & butter	21	16	37	57	25	13	38	66

8. Vehicle responsible (food item incriminated by epidemiological evidence) (59,60)

9. Manner in which incriminated food was marketed: (Check all applicable)

(a) Food Industry (61)
- [ ] Raw 1
- [X] Processed 2
- Home Produced
- [ ] Raw 3
- [ ] Processed 4

(b) Vending Machine [ ] 1 (62)

(c) Not wrapped [ ] 1 (63)
- [X] Ordinary Wrapping 2
- [ ] Canned 3
- [ ] Canned-Vacuum Sealed 4
- [ ] Other (specify) 5

(d) Room Temperature [ ] 1 (64)
- [X] Refrigerated 2
- [ ] Frozen 3
- [ ] Heated 4

If a commercial product, indicate brand name and lot number: Blue Hawk Brand X, USDA Est. #123

10. Place of Preparation of Contaminated Item: (65)
- [ ] Restaurant 1
- [ ] Delicatessen 2
- [ ] Cafeteria 3
- [ ] Private Home 4
- [ ] Caterer 5
- Institution:
- [ ] School 6
- [ ] Church 7
- [ ] Camp 8
- [X] Other, specify 9: NCO Club

11. Place where eaten: (66)
- [ ] Restaurant 1
- [ ] Delicatessen 2
- [ ] Cafeteria 3
- [ ] Private Home 4
- [X] Picnic 5
- Institution:
- [ ] School 6
- [ ] Church 7
- [ ] Camp 8
- [ ] Other, specify 9

HSM 4.245 (NCDC)
Rev 3-69

(Over)

Figure 4

LABORATORY FINDINGS (Include Negative Results)

12 Food specimens examined (67)

Specify by "X" whether food examined was original (eaten at time of outbreak) or check up (prepared in similar manner but not involved in outbreak)

Item	Check: Orig	Check: up	Findings: Qualitative	Findings: Quantitative
Example beef	X		C perfringens, Hobbs type 10	2×10^6 /gm

13 Environmental specimens examined (68)

Item	Findings
Example meat grinder	C perfringens, Hobbs Type 10

14 Specimens from patients examined (stool, vomitus, etc.) (69)

Item	No Persons	Findings
Example stool	11	C perfringens, Hobbs Type 10

15 Specimens from food handlers (stool, lesions etc.) (70)

Item	Findings
Example lesion	C perfringens, Hobbs type 10

16 Factors contributing to outbreak (check all applicable)

		Yes	No
1	Improper storage or holding temperature	☐ 1	☐ 2 (71)
2	Inadequate cooking	☐ 1	☐ 2 (72)
3	Contaminated equipment or working surfaces	☐ 1	☐ 2 (73)
4	Food obtained from unsafe source	☐ 1	☐ 2 (74)
5	Poor personal hygiene of food handler	☐ 1	☐ 2 (75)
6	Other, specify	☐ 1	☐ 2 (76)

17 Etiology (77-78)

Pathogen: Staphylococcus
Chemical:
Other:

Suspected ☐ 1 (79)
Confirmed ☒ 2
Unknown ☐ 3

18 Remarks Briefly describe aspects of the investigation not covered above, such as unusual age or sex distribution, unusual circumstances leading to contamination of food, water, epidemic curve, etc. (Attach additional page if necessary)

Name of reporting agency (80) Veterinary Services, Blank AFB, Tex 76311

Investigating official R. O. Shannon, LtCol, USAF, VC

Date of investigation 6 July 1971

NOTE Epidemic and Laboratory Assistance for the investigation of a foodborne outbreak is available upon request by the State Health Department to the National Communicable Disease Center, Atlanta, Georgia 30333

HSM 4 245 (NCDC) (Back)
Rev 3-69

Figure 5

TIME DISTRIBUTION OF PERSONS AFFECTED	
Time of Onset of Illness After Ingestion of Suspected Meal	Number Ill
Less than 1 hour	4
1-2	10
3-4	16
5-6	8
7-8	6
9-10	2
11 and over	
TOTAL	46

Medical Facility
Blank AFB, Texas

Signature of person completing form
Robert T. Hammer

AF Form 432, Sep 60

120

Figure 6

DEPARTMENT OF VETERINARY MEDICINE

VETERINARY SPECIALIST

1-3

MEDICAL ASPECTS OF FOOD HANDLING

April 1975

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

DO NOT USE ON THE JOB

Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

WB 3ABR90830-IV-1
April 1975

MEDICAL ASPECTS OF FOOD HANDLING

OBJECTIVES

This workbook (WB) contains task knowledges and procedures designed to help you achieve the learning objectives of this block of instruction. The knowledge acquired from using this workbook will help you perform your duties as a veterinary specialist.

PROCEDURES

Answer all questions contained in this workbook using AFM 163-8 and ST 3ABR90830-IV-1 as references.

This supersedes WB 3ABR90830-IV-1, Sep 1974

Questions

1. Define the following terms:

   a. Food-borne illness -

   b. Food poisoning -

   c. Food-borne intoxication -

   d. Food-borne infection -

   e. Contaminated food -

   f. Infective food -

   g. Incubation period -

   h. Ptomaine poisoning -

i. Vulnerable food -

j. Food handler -

2. List the foods which are most often associated with Staphylococcal food poisoning.

3. The Staph organism is universally found. List the locations which would most likely be involved with a food handler handling food.

4. Explain how Staphyloenterotoxicosis can be prevented.

5. List the symptoms of Staphyloenterotoxicosis.

6. List the locations where the organism Clostridium botulinum is commonly found.

7. What is the major distinguishing characteristic of Clostridium botulinum in relation to the causative organism of most other food-borne illnesses?

8. List the types of foods which are more commonly associated with botulism outbreaks.

9. Explain how botulism can be prevented.

10. Explain where the organism Clostridium perfringens is normally found.

11. List tne food items which are most frequently involved in outbreaks of Clostridium perfringens food-borne illness.

12. List the symptoms of Clostridium perfringens food-borne illness.

13. Explain the necessary measures to be taken to prevent outbreaks of Clostridium perfringens food-borne illness from occurring.

14. Explain the difference between a food-borne infection and a food-borne intoxication.

15. List the circumstances necessary for an outbreak of Salmonellosis to occur.

16. List the symptoms of Salmonellosis.

17. Name the foods which are most frequently involved in cases of Salmonellosis.

18. List the more common sources of infectious hepatitis.

19. Explain the reasons why cold foods should be maintained at 45°F or below and hot foods at 140°F or above.

20. Explain the reasons why food handlers are of primary concern in preventing food-borne illnesses.

21. Explain how the physical condition of food service facilities might contribute to outbreaks of food-borne illnesses.

22. Explain the responsibilities of the Base Commander regarding prevention of food-borne illnesses.

23. Explain the responsibilities of the Food Service Officer regarding prevention of food-borne illnesses.

24. List the times when food handlers must receive medical examinations.

25. Explain the preparation and handling of AF Form 535, "Medical Certificate Food Handler."

26. List the areas of surveillance which the supervisor of a food service facility should examine daily.

27. Explain the proper procedures for defrosting frozen foods.

28. Explain the correct method of handling leftovers.

29. List the requirements for preparation and handling of sandwiches as explained in AFM 163-8.

30. Explain the necessary procedures for handling vulnerable foods.

31. List examples of particularly dangerous foods and tell why they are considered "particularly dangerous."

32. Explain the difference between a "vulnerable" food and a "particularly dangerous" food.

33. Explain the purpose of the following steps of the dishwashing procedure:

a. Sorting

b. Waste removal and racking

c. Prewashing

d. Washing

e. Power rinsing

f. Final rinsing

g. Drying

h. Inspecting and unloading

i. Storing

34. List the procedural steps in the "Hot Water Method" of dishwashing and the requirements of each step.

35. List the steps to be followed in dishwashing when sufficient amounts of hot water are not available and the requirements of each step.

36. Name three manuals used in the inspection of food service facilities.

37. Define the following terms as they are used in regard to food and beverage vending:

a. Vending machine

b. Catering point

c. Machine location

d. Readily perishable food

e. Adulterated food

38. What types of foods are prohibited from sale in vending machines unless they are acidified to a pH of 5.0 or lower?

39. List the time requirements relative to the following foods when they are sold in vending machines:

a. Ice cream

b. Dairy products

c. Sandwiches

40. Explain the temperature requirements of vending machines (placement of thermometers, cut off devices, accuracy of thermometers).

41. List the components of a sandwich meal.

42. List the storage requirements of foil pack meals.

43. What should be your main concern when inspecting a food service facility?

44. What requirements must be met in order for the outside area of a food service facility to be rated satisfactory during an inspection?

45. What is the purpose of doing finger plate cultures in a dining facility?

46. What is the purpose of the swab test?

47. Explain why cockroaches need to be controlled in a food service facility.

48. Why is there so much concern about flies being present in a food service facility?

49. Explain what is meant by "physical measures" for controlling insects and rodents.

A-C-SHEPPARD APR '8' 79-1-47

STUDENT TEXT 3ABR90830-V-1
3AZR90870-2-1-3
30BR9921-1-II-9a

DEPARTMENT OF VETERINARY MEDICINE

VETERINARY SPECIALIST

1-3

LABORATORY SERVICES

November 1974

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

DO NOT USE ON THE JOB

PURPOSE OF STUDY GUIDES, WORKBOOKS, PROGRAMMED TEXTS AND HANDOUTS

Study Guides, Workbooks, Programmed Texts and Handouts are training publications authorized by Air Training Command (ATC) for student use in ATC courses.

The STUDY GUIDE (SG) presents the information you need to complete the unit of instruction, or makes assignments for you to read in other publications which contain the required information.

The WORKBOOK (WB) contains work procedures designed to help you achieve the learning objectives of the unit of instruction. Knowledge acquired from using the study guide will help you perform the missions or exercises, solve the problems, or answer questions presented in the workbook.

The STUDY GUIDE AND WORKBOOK (SW) contains both SG and WB material under one cover. The two training publications are combined when the WB is not designed for you to write in, or when both SG and WB are issued for you to keep.

The PROGRAMMED TEXT (PT) presents information in planned steps with provisions for you to actively respond to each step. You are given immediate knowledge of the correctness of each response. PTs may either replace or augment SGs and WBs.

The HANDOUT (HO) contains supplementary training materials in the form of flow charts, block diagrams, printouts, case problems, tables, forms, charts, and similar materials.

Training publications are designed for ATC course use only. They are updated as necessary for training purposes, but are NOT to be used on the job as authoritative references in preference to Technical Orders or other official publications.

Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

ST 3ABR90830-V-1
3AZR90870-2-I-3
3OBR9921-1-II-9a
November 1974

LABORATORY SERVICES

OBJECTIVES

Information provided will assist in preparing you to:

1. Perform appropriate bacteriological, chemical, or physical examinations on selected food items to determine acceptability and contract compliance.

2. Perform appropriate laboratory tests of food service equipment, utensils, and personnel to determine the adequacy of sanitation and hygiene.

INTRODUCTION

The variety of analyses performed in a laboratory can be very useful tools to supplement other techniques used in the food inspection program. The laboratory may be used to identify harmful contaminants in foods, analyze a food product qualitatively and quantitatively, determine the extent of certain biochemical reactions, and identify causative agents of disease.

Likewise, a thorough knowledge in laboratory techniques and procedures will broaden your capabilities in fulfilling the responsibilities pertaining to the medical aspects of the food service sanitation program.

To assist in your use of the text, it has been divided into the following sections:

A. References

B. Categories of Laboratories

C. Collection and Submission of Laboratory Samples

D. Laboratory Forms

E. Laboratory Examinations of Dairy Products and of Food Contact Surfaces

F. Laboratory Examinations of Foods Other than Dairy Products

SECTION A - REFERENCES

The following list includes only the basic references which are needed in performing and/or interpreting the various laboratory procedures which will be discussed or in understanding certain administrative practices/requirements relating to them.

- AFR 163-2, Veterinary Food Inspection
- AFM 163-8, Food Service Sanitation
- AFR 163-9, Veterinary Laboratory Service
- AFR 163-11, Veterinary Service, United States Air Force
- Standard Methods for the Examination of Dairy Products, American Public Health Association
- Official Methods of Analysis of the Association of Official Agricultural Chemists

This supersedes SG 3ABR90830-V-1, June 1973

SECTION B - CATEGORIES OF LABORATORIES

1. Defense Subsistence Testing Laboratory (DSTL) and Army Medical Laboratories. Laboratories authorized to test subsistence for Government procurement are the DSTL, 1819 West Pershing Road, Chicago IL, the five Army Medical Laboratories, and approved commercial laboratories. The DSTL performs verification studies to determine the adequacy of contractor testing facilities and develops criteria for evaluating the reliability of all laboratories in the contractor testing program, including the Army Medical Laboratories. This laboratory also administers a control program for the sanitary evaluation of military subsistence, packaging materials, and marking components, and finally determines condition/fitness and potential storage life of food stocks. Complementing the DSTL are five Army Medical Laboratories, each including a Veterinary Division.

a. Responsibilities of the Veterinary Division of the Army Medical Laboratories. The Veterinary Divisions are responsible for providing laboratory services necessary for support of a complete food inspection program and for the control of diseases transmissible from animals to man.

b. Types of Testing. Laboratory testing of food is usually of four types: special, identification and evaluation, Government acceptance, and verification.

(1) Special Testing. This testing can be authorized by HQ DPSC or by any of the regional headquarters. Such tests may be requested whenever original test results are questionable or when special requirements exist which were not anticipated when a contract was written. The determination of "fitness for issue" of food items in warehouses is also categorized as special testing.

(2) Identification and Evaluation Testing. DPSC requests that nonperishable food items of high dollar value be checked at destination for identity. Examples of such items are bakery mixes, cake mixes, cocoa, mayonnaise, salad dressing, ice cream mixes, egg noodles, and canned soups. Analyses of the components reveal whether the items delivered comply with specifications of the Government contract. Samples of stocks in DPSC storage may be submitted to the laboratory for determination of their remaining storage life (evaluation) or for fitness for issue (special testing) if the food is questioned by the inspector.

(3) Government Acceptance Testing. Tests in this category are done to determine acceptability. Samples are drawn from lots according to the sampling plan for the contract. Dairy products and new food items are tested for acceptance in Government laboratories. Results are reported as "Acceptable with respect to Government Laboratory test requirements" whenever results are satisfactory and the inspector does not need to do lot averaging. When sample or lot averages must be reported, the laboratory will merely report the results of the tests requested.

(4) Verification Testing. Such testing is performed by a Government laboratory to determine the reliability of a contractor's test results or on the verification of a contractor's certificate of conformance. Samples for verification are usually selected only from lots of end items or of components on which verification inspections are being conducted.

2. USAF Environmental Health Laboratories (EHLs). USAF Environmental Health Laboratories are located at Kelly AFB, Texas and at McClellan AFB, California. They provide consultation, professional service, and laboratory support. The EHL at Kelly has veterinary officers assigned and is available for consultation on toxicological aspects of a wide variety of materials.

3. State of City Laboratories. Certain laboratory procedures involving extremely perishable items such as milk may be performed through arrangements with state or city health departments. Unless specifically stated in the contract, reports from these laboratories will not be considered official and may not be used as a basis for instituting price adjustment or action for contract termination. Findings of state or city laboratories can be used for guidance in maintaining surveillance over a product, but they should be used only when difficulties are experienced in shipping products to an official laboratory. State or city laboratories are also used on some occasions for the diagnosis of rabies or other animal diseases which are communicable to man.

4. Base Hospital Laboratories. Some base hospital laboratories have facilities for performing bacteriological and butterfat determinations on dairy products and bacteriological analyses of foods. As is the case with the findings of state or city laboratories, however, the findings of base hospital laboratories may not be used for determining price adjustments or for initiating action for contract termination.

5. Base Veterinary Laboratories. Responsibilities of the base food inspection laboratory may be limited to finger plates, swab tests, coliform counts, standard plate counts, and chemical tests of milk. Again, findings on milk and nongovernment owned foods may not be considered as official for the purposes of instituting price adjustments or contract terminations.

SECTION C - COLLECTION AND SUBMISSION OF LABORATORY SAMPLES

1. Sample Collection. Samples of food items submitted for laboratory analyses are grouped in three categories:

- Those submitted to determine compliance with specification requirements.
- Those submitted for analyses only for certain specific requirements.
- Those submitted for other purposes such as for soundness, estimated storage life, extent of deterioration, fitness for human consumption, detection or identification of foreign material and pathogenic microorganisms.

2. Principles of Sample Collection. Some general principles to keep in mind in sample collection are - proper labeling for identification, selecting a representative sample, using a sterile durable container, providing for adequate refrigeration (when this is necessary), providing for the proper protection of the sample with adequate packaging, and observing postal regulations.

3. General Instructions for Submitting Food Samples to Laboratories. Table 1 provides general instructions for submitting food samples to a laboratory.

SECTION D - LABORATORY FORMS

1. Department of Defense (DD) Form 1222, "Request for and Results of Test," is used for most laboratory analyses of foods. Directions for completing the form are given in the Subsistence Inspection Manual. DD Form 1222 is used for laboratory examinations of items supplied on DPSC contracts. Each set of forms consists of an original and six copies. The original and four copies are sent to the laboratory; one copy is sent to HQ DPSC, ATTN: DPSC-STOP, 2800 So. 20th St., Philadelphia, PA; and one copy is retained in the inspector's files. A statement for analysis for all specification requirements is not always adequate because there may be certain requirements in a particular contract which exceed those listed in the references specification. Always review the contract and list all of the required examinations.

2. When local laboratories (state, city, Base Hospital, or Veterinary Office) are used, results may be recorded on a variety of forms. In all cases, it is imperative that all

necessary data be recorded so that rechecks at a later date will be clear. Since local laboratories do not usually have a file of specifications, requests shall be for results only and not for "specification requirements."

SECTION E - LABORATORY PROCEDURES

This section includes a discussion of the procedures to be followed and the interpretation of results of the more commonly conducted physical and chemical analyses of dairy products, and some of the more common microbiological analyses of dairy products, other foods, and food contact surfaces.

1. The Phosphatase Test for Pasteurization of Milk, Cream, and Ice Cream. This test is performed to determine the adequacy of pasteurization.

a. Equipment and Reagents:

° Dropper, medicine, 12.

° Rack, test tube, laboratory, metal, 14 tube.

° Tablets, set, milk pasteurization.

° N-Butyl alcohol, analytical reagent, 1/4 lb.

° Alcohol, USP, 1 gal.

° Test tube, 13 by 1000 mm, glass-stoppered.

° Water bath (41° to 44° C.) deep enough to immerse glass-stoppered tubes.

b. Procedures:

(1) Dissolve 1 phos-phax tablet in 5 ml of distilled water.

(2) Dissolve 1 indo-phax tablet in 5 ml of absolute ethyl or methyl alcohol.

(3) Add four drops of indo-phax solution to the test tube containing the phos-phax solution, and mix.

(4) Allow to stand 10 minutes. The reason for this is that phos-phax tablets may contain free phenol which could give a false positive reading.

(5) Put 3 ml of N-butyl alcohol into the phos-phax solution and invert the tube 15 times, waiting each time until the alcohol into the phos-phax solution and invert the tube 15 times, waiting each time until the alcohol has risen to the top.

(6) Using a medicine dropper, decant the top layer, which may be blue, and discard. Be careful to insure that all blue color is removed. Repeat steps 5 and 6 at least three times until no color appears.

(7) Dilute the remainder of the phos-phax solution to 50 ml with distilled water.

(8) To 5 ml of the phos-phax solution, add 0.5 ml of thoroughly mixed sample. Shake briefly.

(9) Incubate the tubes in a water bath at 41° to 44° C. for 10 minutes.

(10) After removing the tubes from the water bath, add six drops of indo-phax (BQC) solution, and shake.

(11) Allow the tubes to stand at room temperature for 5 minutes.

(12) Add 2 ml butyl to each tube and extract the color by inverting the tube 12 to 15 times; allow the alcohol to rise to the top after each inversion.

(13) Compare the color with the color standards. Tests which yield two or more units of color are classified as underpasteurized.

(14) All equipment must be washed and rinsed before it is used. Avoid using phenolic resin bottle closures.

(15) Both reagents will decompose with age and must be prepared daily and stored in a refrigerator. Note the expiration dates on tablet bottles. Discard outdated and discolored tablets.

(16) Distilled water should be prepared without using rubber tubing.

(17) An emulsion not separable by centrifugation may form during step 12. Usually, when the tubes are allowed to stand for about 10 minutes, a layer of fluid will appear above the emulsion. Read this layer. Repeat the test when an insufficient amount of fluid appears. The tubes must be completely inverted in order to extract all of the color; they should not be shaken at this stage.

(18) To provide adequate controls, tests will also be made on each of the following - a boiled milk sample, a raw milk sample, a mixed sample of 0.2 to 0.3 percent raw in boiled milk, and a blank composed of 3 drops BQC plus 5 ml phos-phax solution. These controls should give the following results - boiled (less (less than two units of color), raw (dark blue), mixed (3 to 5 units).

2. Babcock Test for Fat in Whole Milk:

a. Equipment and Reagents:

- Bottle, butter fat determination, milk test, Babcock.
- Burette, automatic, 17.5 ml.
- Bottle and pipette, acid, 2 liter.
- Sulphuric acid, technical.
- Centrifuge, laboratory size, 110-volt, AC-DC.
- Water bath deep enough to cover fat column.
- Dividers (nonstandard, purchased locally).
- Pipette, butter fat determination, milk.

b. Procedures:

(1) Mix the sample thoroughly by pouring it back and forth several times because the sample bottle and a mixing glass of suitable size, and adjust the temperature between 16° and 21° C.

(2) Immediately after mixing the sample, put 17.5 ml of the sample into a milk-testing bottle by means of a 17.6 ml pipette (about 0.1 ml will cling to the inside surface of the pipette). To remove the drop remaining in the pipette tip, blow through the pipette after free flow has stopped.

(3) Add 17.5 ml of sulphuric acid (temperature 15° to 20° C.), holding the bottle at an angle and rotating it to wash down any milk that is clinging to the inside of the bottle neck. The acid must be added slowly in three portions and the Babcock bottle should be shaken after each addition.

(4) Shake the bottle in an arc and at fairly rapid speed until its contents are uniformly brown. Then shake it vigorously for about 30 seconds.

(5) Centrifuge the bottles for 10 minutes at 1100 RPMs.

(6) Add enough hot water (above 60° C.) to raise the level of the contents of the bottle to the base of the bottle neck.

(7) Centrifuge the bottles for 2 minutes at 1100 RPMs.

(8) Add enough water (above 60° C.) to float the fat column well up into the neck of the bottle.

(9) Centrifuge the bottles for 1 minute at 1100 RPMs.

(10) Place the bottle in a water bath at 54° to 60° C. (be sure that the water is above the top of the fat column) and leave them for 5 minutes.

(11) Remove a bottle from the water bath. Holding it in a perfectly vertical position, set the spread of a pair of dividers so that one point coincides with the extreme lower part of the lower meniscus and the other part coincides with the upper line of the top meniscus. To insure utmost accuracy, set the calipers on the blank side of the bottle neck. Set one point of the calipers at the zero mark on the bottle, and read directly the percentage of fat from the scale on the neck of the bottle coinciding with the upper point of the dividers.

(12) If very warm acid (above 21° C) which has been in a warm room is used, add a small amount at a time to the sample; after each addition, shake the sample thoroughly until the desired coffee color is produced. Preferably, the acid should be cooled in a refrigerator.

(13) If the milk is warm, add acid in the manner described above.

(14) Both of the above conditions require less acid than a condition in which the milk and acid are between 16° and 21° C. A full amount of warm acid may cause charring and floating of curd particles in the fat column.

(15) Discard all analyses in which curd or charred material is in the fat column, or whenever the reading is indistinct.

3. Roese-Gottlieb Method (Mojonnier Flask) for the Determination of Fat in Frozen Desserts:

a. Equipment and Reagents:

° Hot plate, electric, 2-burner, 110 volt, AC-DC.

° Flask, fat extraction, Mojonnier.

- Mojonnier flask rack (nonstandard, procured locally).
- Hanger, fat extraction, flask.
- Balance accessories.
- Desiccator, with cover, 200 mm.
- Plate desiccator, without feet, 190 mm.
- Water bath and tripod, inoculating.
- Oven, laboratory, drying, medium, 110-220 volt, AC-DC.
- Gauze, absorbent, 36 in. by 100 yds.
- Pipette, serological, 10 ml.
- Flask, Erlenmeyer, 125 ml.
- Beads, glass, laboratory, 1 lb.
- Cylinder, laboratory, graduated, 25 ml.
- Stopper, bottle, rubber, solid, No. 1.
- Distilled water.
- Ammonium hydroxide, ACS, 1 lb.
- Alcohol, ethyl, 1 gal.
- Ether, absolute, ACS, 1 lb.
- Petroleum ether, ACS, 1 lb.
- Calcium chloride, anythydrous, ACS, 1 lb.

b. Preparation of Sample and Procedures:

(1) Place sample in a stoppered glass container, melt at room temperature, and mix by inverting it at least 10 times or by pouring it from one clean container to another several times.

(2) Weigh Mojonnier flask to the nearest 0.0001 Gm.

(3) Measure 5 ml of sample with 10 ml pipette. Remove excess sample from outside of the pipette with gauze. Transfer the measured sample to the Mojonnier flask by placing the pipette halfway to the bottom of the flask before delivery and blowing through the pipette to remove the drop from the delivery end. Reweigh the Mojonnier flask and sample. The difference between the first and second weighing is the weight of the sample.

(4) Add 5 ml of distilled water to the Mojonnier flask.

(5) Add 2 ml of ammonium hydroxide to the Mojonnier flask and mix throughly.

(6) Add 10 ml of ethyl alcohol to the Mojonnier flask and mix thoroughly by shaking 30-60 seconds.

(7) Add 25 ml of ethyl ether. Tilt the flask several times to allow the escape of gases which have formed. Stopper the flask with No. 1 stoppers, invert it lengthwise, and shake it vigorously for 1 minute.

(8) Add 25 ml of petroleum ether. Stopper the flask, invert it lengthwise, and shake it vigorously for 1 minute.

(9) Allow the Mojonnier flask to stand for 20 minutes with the stopper removed.

(10) While the liquids are separating, weigh a 125 ml Erlenmeyer flask containing three glass beads. The flask must already have been dried in an oven and cooled in a desiccator. Record this weight.

(11) At the end of 20 minutes, decant the clear ether layer that has formed in the Mojonnier flask into the Erlenmeyer flask. DO NOT ALLOW ANY OF THE CLOUDY LIQUID TO PASS OVER. Wash the lip and stopper of the Mojonnier flask with equal parts of the two solvents; add the washing to the Erlenmeyer flask.

(12) Place the Erlenmeyer flask with the ether extract on the water bath and slowly evaporate the solvents.

(13) Repeat steps 7 through 9, using 15 ml of each solvent. Decant the ether layer into the Erlenmeyer flask and evaporate the solvents as before.

(14) Again repeat steps 7 through 9, using 15 ml of each solvent. At the end of 20 minutes, add enough distilled water to raise the level of the cloudy liquid into the constriction of the Mojonnier flask so that all the ether layer will pass over. Do not allow any of the cloudy liquid to pass over. Decant the ether layer into the Erlenmeyer flask and evaporate it.

(15) When all the ether has evaporated, dry the Erlenmeyer flask in an oven at 100° C for at least 3 hours (to a constant weight).

(16) At the end of this period, remove the flask from the oven, cool it in the desiccator, and reweight it. Calculate and record this weight.

(17) When milk is analyzed by the Roese-Gottlieb method, follow the procedure that is used for frozen desserts, with the following exceptions:

- Use a 10 ml sample.
- Do not add water.
- Use 1.25 ml ammonium hydroxide (2 ml if the sample is sour).

(18) Insoluble particles in frozen desserts may be broken up by using a malted milk mixer. Mix fruit ice cream for 2 to 5 minutes and nut ice creams for 7 minutes.

(19) If a mixture coagulates after adding both ether solvents, add more alcohol until the emulsion is broken. Do not allow the cloudy layer in the bulb of the Mojonnier tube to rise above the constriction. When the emulsion is not broken by the addition of alcohol, another analysis should be made.

4. Determination of Total Solids and Solids-Not-Fat from specific Gravity of Whole and Skimmed Milk:

a. Equipment:

- Quevenne lactometer.
- Graduate, 250 ml.
- Thermometer (Fahrenheit).

b. Procedures:

(1) Bring the milk as close to 60° F. as is consistent with reasonable speed of testing. Never test any sample that is below 50° F. Mix the sample gently to prevent the incorporation of air by pouring it from one vessel to another several times.

(2) Pour enough milk into the graduate so (with the lactometer floating) it almost overflows.

(3) Center the lactometer in the milk so the lactometer floats freely. Let it assume a constant level.

(4) Read the milk temperature and simultaneously read the lactometer scale at the point where it comes in contact with the surface of the milk.

(5) Record the lactometer reading and the milk temperature and, when necessary, correct the reading to 60° F. See Table 2.

(6) See Table 3 for total solids value. If the table does not show readings that have been taken, total solids may be calculated as follows:

$$\text{Total Solids} = \frac{\text{Corrected Lactometer Reading}}{\text{Percent Fat}} + (1.2 \times \text{Percent Fat})$$

Example: Lactometer reading = 32.5 at 55° F.
Butter Fat = 4.0%
Corrected lactometer reading = 32.5 - 0.5 = 32.0
$\frac{32}{4} = 8$
1.2 x 4.0 = 4.8
8.0 + 4.8 = 12.8% total solids.

(7) Solids-not-fat can be determined by subtracting the percent fat from the total solids.

Example: Fat = 3.5%
Total solids = 12.56%
Solids-not-fat = 12.56 - 3.5 = 9.06%

(8) If an insufficient quantity of milk is submitted to float the standard lactometer, use a 6" Quevenne Lactometer (Kimble Glass Company, Toledo, Ohio) and separate thermometer.

(9) Low total solids in milk with normal fat content indicates that the milk has been watered. Normal solids (not fat value) with a low fat content indicates skimming.

5. Determination of Total Solids and Solids-Not-Fat of Frozen Desserts and Cream:

a. Equipment and Reagents:

° Hot plate, electric, 2-burner, 110 volt, AC-DC.

° Dish, moisture determination.

° Pipette, serological, 10 ml.

° Water bath and tripod, inoculation.

° Desiccator with cover, 200 mm.

° Plate desiccator, without feet, 190 mm.

° Balance, analytical, keyboard.

° Balance accessories.

° Oven, laboratory, drying, medium, 110-200 volt, AC-DC.

° Distilled water.

° Calcium chloride, anhydrous, ACS, 1 lb.

b. Procedures:

(1) For determination of fat, use the procedure outlined under the Roese-Gottlieb method.

(2) Dry an aluminum dish in an oven at 100° C. for at least 3 hours. Cool the dish in a desiccator and weigh it to 0.0001 Gm.

(3) Pipette 1 to 2 Gm of the prepared sample into the dish. Use 2 to 3 Gm for cream.

(4) Reweigh quickly to avoid losing moisture. Record the exact weight.

(5) Add 1 ml of distilled water to the dish and mix thoroughly. It is not necessary to measure or weigh this water.

(6) Place the dish in a water bath for 30 minutes. Tip the dish back and forth occasionally. This is essential to keep a film from forming over the top; this would inhibit drying.

(7) When the sample is almost dry, place the dish in a drying oven at 100° C. for 3 1/2 hours, or until a constant weight is reached.

(8) Remove the dish and its contents from the oven and cool them in a desiccator.

(9) When the dish and contents are cool, weigh them quickly to keep moisture from being absorbed; record this weight.

(10) Calculate the total solids percentage as follows:

Wt. of dish and sample	23.9332 Gm
Wt. of dish	21.6950 Gm
Wt. of sample	2.2382 Gm

Wt. of dish and sample DRY	22.2804 Gm
Wt. of dish	21.6950 Gm
Wt. of total solids	0.5854 Gm

$$\frac{\text{Wt. of total solids} \times 100}{\text{Wt. of sample}} = \% \text{ of total solids}$$

$$\frac{0.5854}{2.2382} = 0.2615 = 26.15\%$$

(11) As a check, place the sample in the oven for another 30 minutes. Cool as before, and reweigh. Compare with results in step 9.

(12) Calculate the solids-not-fat by subtracting the percentage of fat from the percentage of total solids.

Example: 26.16% - total solids
12.16% - fat
14.00% - solids-not-fat

6. Homogenization Test:

a. Equipment and Reagents:

° Cylinder, laboratory, graduated, 100 ml.

° Water-soluble dye.

° Other equipment needed for this procedure is the same as that needed for the Babcock test for butterfat in milk.

b. Procedures:

(1) Rapid Method:

° Thoroughly mix the samples and immediately pour 100 ml into a graduated cylinder.

° Place the sample in a refrigerator at 35° F., and allow it to stand for 8 hours.

° Read the volume of the cream layer. A reading of 2 ml or less indicates a satisfactory product.

° Adding a water-soluble dye to the sample before step 2 may facilitate reading the cream line.

(2) Babcock Test Method:

° Allow the sample to stand for 48 hours. Remove 100 ml from the top of a quart with a 17.6 ml pipette.

° Thoroughly mix the 100 ml remove from the top of the sample and determine its butterfat content.

° Thoroughly mix the remainder of the sample and determine its butterfat content.

° The fat percentage of the top portion shall not differ by more than 10 percent from the fat percentage of the remainder of the sample.

7. Standard Plate Count for Bacteria in Dairy Products:

a. Equipment and Reagents:

° Pipettes, 1.1 ml.

° Pipettes, 11 ml.

° Bottle, dilution, rubber-stoppered, 180 ml.

° Petric dishes.

° Bunsen burner.

° Incubator.

° Water bath of sufficient size to cool agar.

° Sterile buffered distilled water or sterile nontoxic tap water.

° Tryptone glucose extract agar.

° Sterilizer, horizontal autoclave.

° Quebec colony counter.

° Oven, drying.

° Hand talley.

° Flask, Erleynmeyer.

b. Procedures:

(1) Samples. Samples should be plated within 20 minutes after they reach the laboratory. If this is impractical, refrigerate the fluid samples at 0° to 4° and place frozen desserts into a freezing unit. If the interval between procuring the sample and examining it exceeds 4 hours, record this on the report of analysis at the time of examination.

(2) Sterilization of Agar. Sterilize the agar at 121° C. and 15 pounds pressure for 20 minutes. Since sterilization will increase the hydrogen ion concentration and cause a decrease in pH, the pH should be determined on a part of the sterilized agar to insure that the reaction range is within acceptable limits--6.6 to 7.0. After the agar has been sterilized, heat it only enough to melt it for pouring. Avoid resterilization since this tends to form precipitates.

(3) Sterilization of Equipment. Sterilize pipettes, Petri dishes, and bottles in a hot air sterilizer at not less than 160° C. for not less than 1 hour.

(4) Preparation of Sample. Fluid dairy products should be sampled directly from their original containers. Wipe the lip of the container with alcohol or expose it to a flame. For frozen dairy products, open the container aseptically, and transfer a representative portion (about 100 ml) to a sterile widemouth bottle. Replace the stopper and allow the sample to melt at room temperature for not more than 15 minutes, or if the sample will not melt at room temperature during this period, place it in a 40° C. water bath (only until melted).

(5) Plating Procedures:

° Keep sample refrigerated (0° to 4° C.) until time of plating.

° Melt agar in water bath or sterilizer at a temperature of 43° to 45° C.

° Wipe the table top with 5 percent creosol solution.

° Arrange Petri dishes (as in figure 1) and mark them as follows:

°° Control on dilution bottle number 1 and agar.

°° Control on dilution bottle number 2 and agar.

°° Control on dilution bottle number 3 and agar. (When difficulty is encountered with contamination, separate agar and water controls should be set up to determine the cause of contamination.)

°° Dilution 1/100.

°° Dilution 1/1,000.

°° Dilution 1/10,000.

° Have dilution bottles filled so that the lead after sterilization is about 1 ml above the 99 ml mark. Label the first dilution bottle number 1, the second dilution bottle number 2, and the third dilution bottle number 3. Using a separate sterile 1 ml pipette for each dilution blank, remove enough buffered distilled water to bring the level down to the 99 ml mark and place this portion in the control Petri dish. Replace the stopper immediately after the control portion has been removed.

° Shake the container (and all dilutions prepared thereafter) 25 times within 7 seconds using a one foot up-and-down motion.

° Transfer 11 ml of the sample to dilution bottle number 1 with a sterile 11 ml pipette; or for cream and frozen desserts, weigh 11 Gm of the prepared sample into dilution bottle number 1, using a prescription balance and a sterile 11 ml pipette. Replace the stopper and shake the dilution bottle. Discard the used pipette.

° Using a sterile 11 ml pipette, transfer 11 ml of the diluted sample from dilution bottle number 1 into dilution bottle number 2. Discard the used pipette, stopper and shake dilution bottle.

° Using a sterile 11 ml pipette, transfer 11 ml of the diluted sample from dilution bottle number 2 to dilution bottle number 3. Discard the used pipette, stopper and shake the dilution bottle.

° Using a sterile 1.1 ml pipette, transfer 1 ml from dilution bottle number 2 to a sterile Petri dish, marked with sample number, date, and 1/100. Discard the used pipette.

° Using a sterile 1.1 ml pipette, transfer 0.1 ml from dilution bottle number 3 to another Petri dish, marked with sample number, date and 1/1,000.

° Transfer the remaining 1 ml in the pipette to the third Petri dish, marked with sample number, date, and 1/1,000. Discard the used pipette.

° Add about 10 to 12 ml of liquified agar (44° to 46° C.) to each plate. Pour dilution control number 1, then the three milk dilution plates, and lastly the dilution controls number 2 and number 3. This procedure will give a check on agar sterility before and after pouring the milk dilution plates. Before pouring each plate, sterilize the lip of the agar flask by exposing it to a flame.

° Allow the agar in the Petri dishes to solidify, invert them, and place them in an incubator at 32° to 35° C. for 48± 3 hours.

(6) Counting Procedures. Select plates containing between 30 and 300 colonies and count all colonies, including those of pinpoint size. Multiply the number found by the dilution factor. Report as standard plate count per ml or standard plate count per Gm (cream and frozen desserts). Special rules of the US Public Health Service Grade A Pasteurized Milk Ordinance for reporting bacteria counts are:

° When the higher plate count is more than twice the lower, record the lower; and

° When the higher plate count is not more than twice the lower, apply the "standard methods rules" for counting. These may be summarized as follows: If one plate cannot be counted because a spreader covers more than half of it, the result is to be reported as unsatisfactory unless the count of the other plate is within the allowable limits for the type of product. Report bacterial plate counts to the nearest 1,000 unless the count exceeds 100,000. In this case, report to the nearest 10,000 unless the count exceeds 1,000,000, in which case report to the nearest 100,000. If no plate shows growth, the result is to be reported as unsatisfactory.

8. Testing Dairy Products for Organisms of the Coliform Group:

a. Equipment and Reagents:

° Desoxycholate agar.

° Eosin methylene blue agar.

° Brilliant green bile broth.

° Lactose broth.

° Nutrient agar.

° Nutrient broth.

° Inoculating needle--holder, needle, kolle, 10 in.

° Other equipment as listed under standard plate count.

b. Preparation of Sample. Proceed as outlined under standard plate count. Immediately before removing the test portion, shake the samples 25 times within 7 seconds, using a one foot up and down motion.

c. Sterilization of Media:

(1) Desoxycholate Agar. Do not autoclave this agar since excessive heat is detrimental. The agar will be sterilized if heated to boiling, stirring frequently while dissolving the media in distilled water.

(2) Other Media. Autoclave at 121° C. and 15 pounds pressure for 15 minutes.

d. Sterilization of Equipment. Sterilize pipettes and Petri dishes in a hot air sterilizer at not less than 160° C. for at least 1 hour.

e. Procedures:

(1) Presumptive Test:

° Place 1 ml of the sample into each of three Petri dishes, using an 11 ml graduated pipette.

° Pour about 10 ml of sterile desoxycholate agar which has been melted and cooled to 44° to 46° C., into each of the Petri dishes. Mix the sample and agar by rotating the dishes gently, and allow the agar to harden.

° After the agar and milk mixture in the Petri dishes has hardened, cover the mixture with a layer of desoxycholate agar (5 ml) and allow this layer to harden.

° Place the Petri dishes, inverted, into an incubator at 35° C. for 24 hours.

° Using a Quebec colony counter, count all dark red colonies measuring at least 0.5 mm in diameter, average the count from the three plates, and report the results as coliform count per ml.

(2) Completed Test:

° Select a typical colony, transfer it to a lactose broth fermentation tube, and incubate the tube at 35° C. until gas appears (24 to 48 hours).

° For each of the positive fermentation tubes, streak an eosin methylene blue agar plate. It is advisable to make the transfer as soon as possible after gas has formed in the tubes.

° Incubate the plates at 37° C. for 18 to 24 hours.

° Remove the plates from the incubator and pick one or more typical colonies; if no typical colonies are present, pick two or more which are considered most likely to be organisms of the coliform type, and transfer each to both a nutrient agar slant and a lactose broth fermentation tube. Typical colonies of the coliform group are dark with a metallic green sheen (Escherichia) or white with a dark center (Aerobacter).

° Incubate (37° C.) the agar slant for 24 hours, and the lactose broth for 48 hours.

° Make a gram stain on a smear from the agar slant.

f. Interpretation. The formation of gas in the lactose broth and the finding of gram-negative, nonspore forming, rod-shaped bacteria with the absence of spore-forming bacilli constitute a positive completed test. If all these conditions are not satisfied, the test is negative. For routine analysis, only the presumptive solid media test need be made as the media are selective for coliform organisms. When typical colonies are observed, and as an occasional check on colonies considered to be coliform, use the completed test for confirmation.

9. APHA Rinse Test:

a. Equipment and Reagents:

° Pipettes, 10 ml.

° Petri dishes.

° Tryptone glucose extract agar.

° Bunsen burner.

° Sodium thiosulfate.

° Sterile buffered water.

b. Preparation of Reagents. Follow the procedure outline for the standard plate count and the comments below.

c. Procedures:

(1) Mark six sterile Petri dishes as follows:

° Agar control (before pouring).

° Dilution control.

° Laboratory number of container.

° Laboratory number of container.

° Laboratory number of container.

° Agar control (after pouring).

(2) Transfer 1 ml of the sterile buffered water to a Petri dish (dilution control), using a 10 ml pipette.

(3) Using the same pipette, transfer 20 ml of sterile water to the container to be tested (after flaming the mouth of the container).

(4) Rinse the walls of the container thoroughly by shaking it and rotating it 25 times.

(5) Pipette 10 ml of the water from the container and divide it into about equal amounts among three Petri dishes.

(6) Pour about 10 ml of cooled (44° to 46° C.) liquid agar into each of the entire series of Petri dishes. Mix the samples with the agar by tilting and ortating the dishes carefully.

(7) Invert the plates and incubate them at 35° C. for 48 hours.

(8) Examine the control plates for growth. If there is growth in any of these plates, the test should be disregarded.

(9) Count bacterial colonies in the other plates. Multiply the sum by three and record as "Estimated Number of Colonies per Bottle."

(10) If residual chlorine is present in the containers, buffered distilled water with sodium thiosulfate solution (dissolve 25 Gm $Na_2 S_2O_3 \cdot 5H_2O$ in 1 liter of boiled distilled water; filter and store in refrigerator) should be used for rinsing.

10. Swab Test:

a. Equipment and Reagents:

° Sterile 1.1 ml pipettes.

° Sterile Petri dishes.

° Bunsen burner.

° Bacteriological incubator.

° Wax pencils for marking plates.

° Alcohol burner.

° A thin flexible sheet metal frame or sterile stiff paper with an opening 2" X 2".

° Sterile, 1/2 x 100 mm bacteriological test tubes with cork or rubber stopper, containing 5 ml of sterile buffered distilled water, and a nonabsorbent cotton swab on a wire holder. The wire holder should be stiff, inserted into the stopper, and extended down into the tube so that the swab will be bathed in the buffered distilled water.

b. Procedures:

(1) Utensils to be examined should include glasses, cups, spoons, knives, forks, plates, etc. Five of each that are to be tested shall be selected at random from the area in which clean utensils are stored.

(2) Use one swab for each group of five similar utensils--e.g. cups, glasses, etc. Squeeze excess water from the swab against the inside of the test tube, and proceed with the swabbing technique.

° For examining cups, bowls, etc., rub the swab slowly and firmly three times over the significant surface of five similar utensils. The significant surface will consist of the upper 1/2 inch of the inner and outer surface (4 square inches).

° For examining forks, spoons, etc., the entire mouth contact surface of five similar utensils will be swabbed.

° For examining saucers, plates, etc., use either a guide made of sheet metal or sterile stiff paper, each with an opening of 2" x 2". Place this guide on the flat surface and swab the exposed area three times. Swab five similar utensils with one swab.

° Following the swabbing of each utensil, return the swab to the sterile buffered distilled water tube, shake it 25 times, squeeze out the water, remove the swab from the tube, and swab the next similar utensil. After the five similar utensils have been swabbed, return the swab to the buffered distilled water, pack the tube in crushed ice and return to the laboratory as soon as possible, preferably within 4 hours. All swabs should be returned to the laboratory, properly labeled. All pertinent information about the test will be supplied to the laboratory.

° Shake the swab containers for 2 minutes in an automatic shaking machine, or agitate the containers vigorously by striking them against the palm of the hand rapidly for 2 minutes.

° Remove the swab, pressing it against the inside wall of the container to expel as much moisture as possible.

° Flame the mouth of the tube and transfer 1 ml of the dilution water to each of five sterile Petri dished.

° Add 10 to 12 ml of melted sterile tryptone glucose agar to each Petri plate, mix at 37° C, allow the agar to solidify, incubate the plate, and count as in making a standard plate count.

° The average number of colonies on the five Petri plates will be considered to be the number of bacteria per utensil.

c. Interpretation of Test: The commonly accepted tolerance, as established by the USPHS, is NMT 80 colonies per eight square inches. Therefore, the average number of colonies on the five Petri plates should be compared with the established tolerance. Higher counts are presumptive evidence of inadequate cleansing, inadequate bactericidal treatment or recontamination by improper handling during storage.

SECTION F: LABORATORY EXAMINATIONS OF FOODS OTHER THAN DAIRY PRODUCTS

1. Microorganisms on the Outside and Inside of a Piece of Beef:

a. Weigh out, on waxed paper, 11 g from the outside of a large cubical piece of beef and another 11 g from the center. (To obtain a center sample, sear the outside or paint it with iodine; but the meat with sterile knives.)

b. Place each 11 g of meal in a sterilized mortar containing sterile sand and grind rapidly.

c. Transfer the sand and ground meat to a 99 ml water blank and shake well (or prepare a 1:10 dilution by emulsifying 11 g of meat for 3 min. in 99 ml of diluent in a sterile mechanical blender cup).

d. Pour duplicate plates of 1:10 and 1:100 dilutions of the inner tissue and 1:100 and 1:1000 dilutions of the outer tissue, using plate count agar.

e. Incubate at room temperature for 5 days or at 30° C. for 2-3 days. Count total numbers of yeasts, molds and bateria, and numbers of chromogens spreading and other bacteria. Record results in tabular form.

2. Microbiological Examination of Eggs:

a. Shell egg: Brush with soap and water; drain; immerse in 70 percent alcohol for 10 mins.; drain off alcohol and flame the egg. Puncture a 0.5 inch hole in the small end; flame there; invert over opening of sterile container and empty into it by heating the blunt end of the egg. If desired, mix parts of the egg with a sterile spoon or a mixer.

b. Liquid eggs: Mix sample to homogeneity.

c. Frozen eggs: Thaw sample rapidly and mix to homogeneity.

d. Dried eggs: Mix warmed up powder to homogeneity.

e. Weigh 11 g of shell, liquid, frozen, or dried egg into a 99 ml salt dilution blank with glass beads; shake 25 times.

f. Plate count: Pour duplicate plates with plate count agar of the 1:100; 1:1000; 1:10,000 dilutions. Incubate plates at 30° to 32° C. for 2-3 days or at room temperature for 5 days. Count and differentiate types of colonies. Report as numbers per gram.

g. Yeast and mold count: Plate 1:10 and 1:100 dilutions with acidified potato dextrose agar. Incubate as for plate count; report as yeasts and molds per gram.

h. Direct microscopic count: Spread 0.01 ml of liquid or thawed egg by means of a Breed pipette over 1 sq. cm area of a single microscope slide (or 0.01 ml of a 1:10 dilution of dry egg over 2 sq. cm); dry; treat 1 min. with xylene, then 1 min. with 95 percent alcohol. Remove; air dry. Stain 1 min. with North's aniline oil methylene blue stain; wash well; dry and examine. Count 100 fields and report as bacteria or clumps per gram of egg material.

3. Dressed, Eviscerated Poultry:

a. Observe appearance of bird and not odor.

b. Total count: Prepare contact plates from chicken surface as follows:

(1) Pour aluminum contact plate heaping full of melted and cooled plate count agar. This gives a surface area of 16 sq. cm. Allow it to solidify while in the Petri dish.

(2) Handling the plate by a tab, press the agar surface of the contact plate firmly against the skin of the bird (without sliding) for 3 sec.

(3) Incubate the contact plate, agar side up, in a sterile Petri dish for 2 days at 30° to 32° C.

(4) Count colonies on a colony counter and report as count per sq. cm of skin.

c. Alternative method:

(1) Apply a sterile template with an opening of 12 sq. cm onto the skin of a bird and swab the area with a sterile swab, rolling it during the operation. Moisten the swab first with dilution water if the bird's skin is dry.

(2) Break off the lower end of the swab into a sterile 99 ml dilution bottle (containing 0.85 percent saline). Shake the bottle 50 times. Pour dilution plates in duplicate with plate count agar as directed, making further dilutions in saline blanks.

(3) Incubate the plates for 2-3 days at 30° to 32° C. Report as total count per sq. cm of skin.

4. Dried Fruits:

a. Preparation of sample: Count out pieces of dried fruit, weigh them, and add them to sterile water to soak for 30 min. at room temperature; then shake for 1-3 min. Use 20 pieces of apples, apricots, peaches, etc. in 200 ml of sterile water; 10 bisected pieces of prunes, figs, dates in 100 ml of sterile water; 100 pieces of raisins, currants, cherries, etc. in 200 ml of sterile water.

b. Microbiological examination:

(1) Total count: Plate 1 ml and 0.1 ml of soaked samples in duplicate with plate count agar; incubate at 30° to 32° C. for 2-3 days.

(2) Yeasts and molds: Plate 1 ml in duplicate with acidified potato dextrose agar; incubate 5-7 days at 30° C.

(3) Express results as numbers per gram of sample and tabulate results.

5. Dried Vegetables:

a. Preparation of sample: Weigh 10 to 20 g of the dried vegetables into a bottle of flask; add 180 to 190 ml (total of 200 g vegetable + sterile water) of sterile water; soak 30 min. at refrigerator temperature; then shake for 2-3 min.

b. Microbiological examination:

(1) Total count: Plate 1 ml, 0.1 ml or higher dilutions in duplicate with plate count agar; incubate at 30° to 32° C. for 2-3 days and report as numbers per gram of sample.

(2) Lactic acid bacteria: Plate same dilutions with orange serum agar (medium 12). Test colonies for catalase.

(3) Thermophilic sporeformers: Boil liquid of original sample for 5 min.; replace evaporated moisture; culture for kinds of thermophiles.

(4) Direct microscopic examination: Examine a Breed smear of the original soaking liquid, fixing with heat or methyl alcohol, and staining with North's aniline oil methylene blue stain. Report as estimated numbers of microorganisms per gram of product.

(5) Express results as numbers per gram and tabulate results.

6. Frozen Vegetables:

a. Preparation of sample:

(1) For peas, lima and green beans, cut corn, etc.: Break contents without opening package; sample with a sterile spoon or knife from different parts of the package.

(2) For spinach, asparagus, cauliflower, broccoli; defrost at room temperature for 2 hours; sample from different parts of the package.

(3) Weigh 50 g into 450 ml sterile water in a sterile mechanical blender cup and blend for 2 min.; then let stand for 2 min. Resuspend and pipette 11 ml into a 99 ml water blank. If a blender is not available, weigh 11 g of vegetable into a sterile sand; grind thoroughly; transfer to a 99 ml water blank.

b. Total count: Plate 1:100 and 1:1,000 dilutions in duplicate with plate count agar. Incubate for 3-4 days at 30° to 32° C. Count colonies and express as numbers per gram.

c. Direct microscopic count: Blend 50 g of vegetable plus 100 ml of distilled water (sterile) for 2 min. With a Breed pipette, spread 0.01 ml over 1 sq. cm on a slide; dry; fix (heat or methanol). Stain with North's aniline oil methylene blue stain, rinse, dry, and count 100 fields. Report as microorganisms per gram.

7. Frozen Fruits:

a. Preparation of sample: After defrosting for 2 hours at room temperature, sample proportional parts of fruit and sirup from different parts of the package. Then proceed as in 6a(3) above.

b. Total count: Proceed as in 6b above.

c. Direct microscopic count: Proceed as in 6c above.

8. Precooked Frozen Foods:

a. Preparation of sample: Proceed as in 6a except that with precooked frozen meals each part of the meal must be sampled, in whole or in part.

b. Total count: Proceed as in 6b.

c. Yeasts and molds: Plate recommended dilutions in duplicate with acidified potato dextrose agar and incubate at 21° C. for 3-5 days. Express as yeast and mold colonies per g of product.

d. Direct microscopic count: Proceed as in 6c.

9. Frozen Fish or Meat (raw or precooked):

a. Defrost at room temperature for 2 hrs.; sample from different parts of the product.

b. Weigh 50 g of the product into 450 ml sterile water in a sterile mechanical blender cup and blend for 2 min.; then let stand for 2 min. Resuspend and pipette 11 ml into a 99 ml water blank. If a blender is not available, weigh 11 g of the product into a sterile mortar with sterile sand; grind thoroughly; transfer to a 99 ml water blank.

c. Total count: Plate 1:100 and 1:1,000 dilutions in duplicate with plate count agar. Incubate for 3-4 days at 30° to 32° C. Count colonies and express as numbers per gram.

10. Examination of Finished Beverage:

a. Sampling: Open bottle aseptically; flame the lip; remove the sample with a sterile 10 ml pipette. Or wash a flat-top can, wipe the end with alcohol; puncture the can with a sterile awl or other opener; and sample. (Carbonated beverages should be opened and warmed as hour before sampling to permit the gas to escape. Be sure that the measured aliquot is all liquid, not partly gas.)

b. Total plate count: Plate 1 ml and 0.1 ml portions in duplicate with plate count agar. Incubate for 2-3 days at 30° to 32° C. Count the plates.

c. Yeasts and Molds: Plate duplicate 1 ml portions with acidified potato dextrose agar. Incubate for 3 and 5 days at 30° to 32° C. and count.

d. Report as numbers per ml of beverage.

e. Detection of coliform bacteria: From each sample of beverage inoculate 5 ml into a fermentation tube of buffered lactose broth (medium 16). Incubate at 35° C. for 48 hours and examine for gas. The finished beverages should meet the requirements for drinking water as tested by the A.P.H.A. Standard Methods for the Examination of Water and Sewage.

11. Examination of Ingredients (sugar, sirup, flavors, and colors):

a. Preparation of sample and plating:

(1) Sugar: Weigh 20 g of sugar into a 6 oz. bottle or a 150 ml Erlenmeyer flask with the 100 ml level marked and fill to the 100 ml mark with sterile water. Plate 5 1-ml portions into 5 Petri dishes with plate count agar for total counts, incubating at 30° to 32° C. for 3 days; and plate 5 1-ml portions with acidified potato dextrose agar, incubating at 30° to 32° C. for 3 days or 5 days for yeast and mold counts. Count in 3 days if molds tend to overgrow the plates, otherwise in 5 days. Report as numbers of mesophiles and as yeast and mold colonies per 10 g of sugar.

(2) Sirup (liquid sugar): Take a portion which when diluted with sterile water to 100 ml will result in a 20 percent sugar solution. Follow procedures as for sugar.

(3) Flavor and color: Pour duplicate plates with 1 ml and 0.1 ml portions of stock solution, pouring 4 plates with plate count agar for total counts, with incubation at 30° to 32° C. for 3 days, and 4 plates with acidified potato dextrose agar for yeast and mold counts, with incubation at 30° to 32° C. for 3 and 5 days. Report as numbers of mesophiles per ml and numbers of yeast and mold colonies per ml (or per gram of dry material if stock solution was made up from it).

TABLE 1 - GENERAL INSTRUCTIONS FOR SUBMISSION OF FOOD SAMPLES TO THE LABORATORY

SPECIMEN AND TYPE OF ANALYSIS	AMOUNT	INSTRUCTIONS
Bottled fluid dairy products, fresh (includes samples in paper container)	Unopened container (1/2 pint minimum)	Samples will be submitted in original unopened containers, packed in cracked ice (not dry ice) so that the container remains in an upright position, and no liquid reaches the lid or cap. Samples will be delivered to the laboratory as rapidly as is practicable, within 4 hours of the suggested maximum expiration of time between collection and delivery. Temperature of sample should not exceed 40°F.
Bread Chemical	Minimum of 3 slices	Sample should be packed in a sealed plastic bag and placed in a protective outer container or be submitted as an entire unopened loaf.
Bulk fluid and frozen dairy products, fresh Bacteriological, chemical, and/or microscopic	Minimum of 200 ml in sterile 8125-408-9195 container.	Fluid samples will be treated as bottled fluid dairy products above and frozen desserts will be treated as packaged frozen desserts below.
Butter Bacteriological, chemical, and/or microscopic	One pound in original container, or sealed plastic bags.	Samples shall be refrigerated, if submitted during warm weather, and no moisture allowed to enter sample container. If mailed, 8115-682-6525 container will be used.
Cheese, natural and process Chemical	1/2 pound in original container inside of sealed plastic bag.	Do not add a preservative. Sample may be shipped unrefrigerated, or packed in dry ice (preferred method during hot weather).
Cottage cheese Chemical	Minimum of a 10 Gm. sample	Submitted in original container, in stock item 8125-408-9195 or similar container, either refrigerated or preserved with formalin.
Dry milk Bacteriological and chemical	Original container or one pound in sterile container	A representative sample should be aseptically submitted to the laboratory.
Evaporated milk Bacteriological and chemical	Two cans from each lot	Packaged to prevent damage during transit.

TABLE 1 - GENERAL INSTRUCTIONS FOR SUBMISSION OF FOOD SAMPLES TO THE LABORATORY (Contd)

SPECIMEN AND TYPE OF ANALYSIS	AMOUNT	INSTRUCTIONS
Flour Chemical	Minimum of 50 Gm. in original container or 8125-408-9198 container	Packaged to prevent damage during transit.
Fluid and frozen dairy products, preservative added Chemical and/or microscopic	Minimum of 120 ml in sterile 8125-405-6400 and 8110-687-8027 containers	A representative portion of the fluid sample will be used to fill the bottle completely. The frozen sample will be melted and a representative portion placed into the bottle. All bottles shall be checked before shipment to insure that no air bubbles are present. Presence of preservative and quantity must be noted on the label. The preservative of choice is 1cc of 2% merthiolate per 120cc of fluid milk.
Beef, Ground or boneless Chemical	One pound in sealed plastic bag and outer mailing case	Collect portions at regular intervals, regrind with a meat grinder, mix well and place approximately one pound in airtight glass container or plastic bags. To prevent decomposition during warm weather, add 2 ml formalin per pound.
Oleomargarine	One pound in original carton, or sealed plastic bag	Packaged to prevent damage in transit, and if not submitted in original carton, shipped in 8115-682-6525 for protection of bottle.

TABLE 1 - GENERAL INSTRUCTIONS FOR SUBMISSION OF FOOD SAMPLES TO THE LABORATORY (Contd)

SPECIMEN AND TYPE OF ANALYSIS	AMOUNT	INSTRUCTIONS
Oil, vegetable salad Chemical	Original container or 250 ml in 8110-687-8027 container	Packaged to prevent breakage in transit.
Sausage, bologna, frankfurters, liverwurst, pork, and salami Chemical	One pound or six links in sealed plastic bags	Sample will be submitted in a tightly sealed container and, if a preservative is necessary, 2 ml. of formalin per pound of sample will be used.
Tomato puree Chemical	One pint in original container or full 8125-408-9195 container	Packaged to prevent breakage in transit.
Frozen dairy products, fresh, frozen Bacteriological, chemical, and/or microscopic	Unopened container (1/2 pint minimum)	Samples will be submitted in original unopened container packaged in dry ice so that the specimens arrive frozen and so that any insulating material used does not contaminate the specimen.
Lard and shortening Chemical	Minimum of one pound in unopened container or sealed plastic bag	Sample should be placed in the glass container tightly sealed and packaged in 8115-682-6525 container. Metal containers should not be used unless submitted in original unopened container.
Mayonnaise and salad dressing Chemical	Minimum of one pint	Submit in unopened original container packed to prevent breakage.
Meat and noodles or meat and spaghetti Chemical	Four ounces in original container	Packaged to prevent damage in transit.
Milk containers Bacteriological	Sealed container	Submit sealed refrigerated container within 4 hours of collection.

TABLE 2 - CORRECTION TABLE FOR VARIATION IN TEMPERATURE

Lactometer Reading	Temperature 0°F.									
	51	52	53	54	55	56	57	58	59	60
20	19.3	19.4	19.4	19.5	19.6	19.7	19.8	19.9	19.9	20.0
21	20.3	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.9	21.0
22	21.3	21.3	21.4	21.5	21.6	21.7	21.8	21.9	21.9	22.0
23	22.3	22.3	22.4	22.5	22.6	22.7	22.8	22.8	22.9	23.0
24	23.3	23.3	23.4	23.5	23.6	23.6	23.7	23.8	23.9	24.0
25	24.2	24.2	24.4	24.5	24.6	24.6	24.7	24.8	24.9	25.0
26	25.2	25.2	25.3	25.4	25.6	25.6	25.7	25.8	25.9	26.0
27	26.2	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0
28	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0
29	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0
30	29.1	29.1	29.2	29.3	29.4	29.6	29.7	29.8	29.9	30.0
31	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.8	30.9	31.0
32	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.9	32.0
33	31.9	32.0	32.1	32.3	32.4	32.5	32.6	32.7	32.9	33.0
34	32.9	33.0	33.2	33.2	33.3	33.5	33.6	33.7	33.9	34.0
35	33.8	33.9	34.0	34.2	34.3	34.5	34.6	34.7	34.9	35.0

Lactometer Reading	Temperature °F.									
	61	62	63	64	65	66	67	68	69	70
20	20.1	20.2	20.2	20.3	20.4	20.5	20.6	20.7	20.9	21.0
21	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	22.0	22.1
22	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	23.0	23.1
23	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	24.0	24.1
24	24.1	24.2	24.3	23.4	24.5	24.6	24.7	24.9	25.0	25.1
25	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.9	26.0	26.1
26	26.1	26.2	26.3	26.5	26.6	26.7	26.8	27.0	27.1	27.2
27	27.1	27.3	27.4	27.5	27.6	27.7	27.8	28.0	28.1	28.2
28	28.1	28.3	28.4	28.5	28.6	28.7	28.8	29.0	29.1	29.2
29	29.1	29.3	29.4	29.5	29.6	29.7	29.9	30.1	30.2	30.3
30	30.1	30.3	30.4	30.5	30.7	30.8	30.9	31.1	31.2	31.3
31	31.2	31.3	31.4	31.5	31.7	31.8	31.9	32.1	32.2	32.4
32	32.2	32.3	32.5	32.6	32.7	32.9	33.0	33.2	33.3	33.4
33	33.2	33.3	33.5	33.6	33.8	33.9	34.0	34.2	34.3	34.5
34	34.2	34.3	34.5	34.6	34.8	34.9	35.0	35.2	35.3	35.5
35	35.2	35.3	35.5	35.6	35.8	35.9	36.1	36.2	36.4	36.5

TABLE 3 - TOTAL SOLIDS FROM SPECIFIC GRAVITY

Percentage of fat	Lactometer Reading at 60°F. (Quevenne degrees)										
	26	27	28	29	30	31	32	33	34	35	36
2.5	9.50	9.75	10.00	10.25	10.50	10.75	11.0	11.26	11.51	11.76	12.01
2.6	9.62	9.87	10.12	10.37	10.62	10.87	11.12	11.38	11.63	11.88	12.13
2.7	9.74	9.99	10.24	10.49	10.74	10.99	11.24	11.50	11.75	12.00	12.25
2.8	9.86	10.11	10.36	10.61	10.86	11.11	11.37	11.62	11.87	12.12	12.37
2.9	9.98	10.23	10.48	10.73	10.98	11.23	11.49	11.74	11.99	12.24	12.49
3.0	10.10	10.35	10.60	10.85	11.10	11.36	11.61	11.88	12.11	12.36	12.61
3.1	10.22	10.47	10.72	10.97	11.23	11.48	11.73	11.98	12.23	12.48	12.74
3.2	10.34	10.55	10.84	11.09	11.35	11.60	11.85	12.10	12.35	12.61	12.86
3.3	10.46	10.71	10.96	11.22	11.47	11.72	11.97	12.22	12.48	12.73	12.98
3.4	10.58	10.83	11.09	11.34	11.59	11.84	12.09	12.34	12.60	12.85	13.10
3.5	10.70	10.95	11.21	11.46	11.71	11.96	12.21	12.46	12.72	12.97	13.22
3.6	10.82	11.08	11.33	11.58	11.83	12.08	12.33	12.58	12.84	13.09	13.34
3.7	10.94	11.20	11.45	11.70	11.95	12.20	12.45	12.70	12.96	13.21	13.46
3.8	11.06	11.32	11.57	11.82	12.07	12.32	12.57	12.82	13.08	13.33	13.58
3.9	11.18	11.44	11.69	11.94	12.19	12.44	12.69	12.94	13.20	13.45	13.70
4.0	11.30	11.56	11.81	12.06	12.31	12.56	12.81	13.06	13.32	13.57	13.83
4.1	11.42	11.68	11.93	12.18	12.43	12.68	12.93	13.18	13.44	13.69	13.95
4.2	11.54	11.80	12.05	12.30	12.55	12.80	13.05	13.31	13.56	13.82	14.07
4.3	11.66	11.92	12.17	12.42	12.67	12.92	13.18	13.43	13.68	13.94	14.19
4.4	11.78	12.04	12.29	12.54	12.79	13.04	13.30	13.55	13.80	14.06	14.31
4.5	11.90	12.16	12.41	12.66	12.91	13.16	13.42	13.67	13.92	14.18	14.43
4.6	12.03	12.28	12.53	12.78	13.03	13.28	13.54	13.79	14.04	14.30	14.55
4.7	12.15	12.40	12.65	12.90	13.15	13.40	13.66	13.91	14.16	14.42	14.67
4.8	12.27	12.52	12.77	13.02	13.27	13.52	13.78	14.03	14.28	14.54	14.79
4.9	12.39	12.64	12.89	13.14	13.39	13.64	13.90	14.15	14.40	14.66	14.91
5.0	12.51	12.76	13.01	13.26	13.51	13.76	14.02	14.27	14.52	14.78	15.03
5.1	12.63	12.88	13.13	13.38	13.63	13.89	14.14	14.39	14.64	14.90	15.15
5.2	12.75	13.00	13.25	13.50	13.75	14.01	14.26	14.51	14.76	15.02	15.27
5.3	12.87	13.12	13.37	13.62	13.87	14.13	14.38	14.63	14.88	15.14	15.39
5.4	12.99	13.24	13.49	13.74	14.00	14.25	14.50	14.76	15.01	15.26	15.51

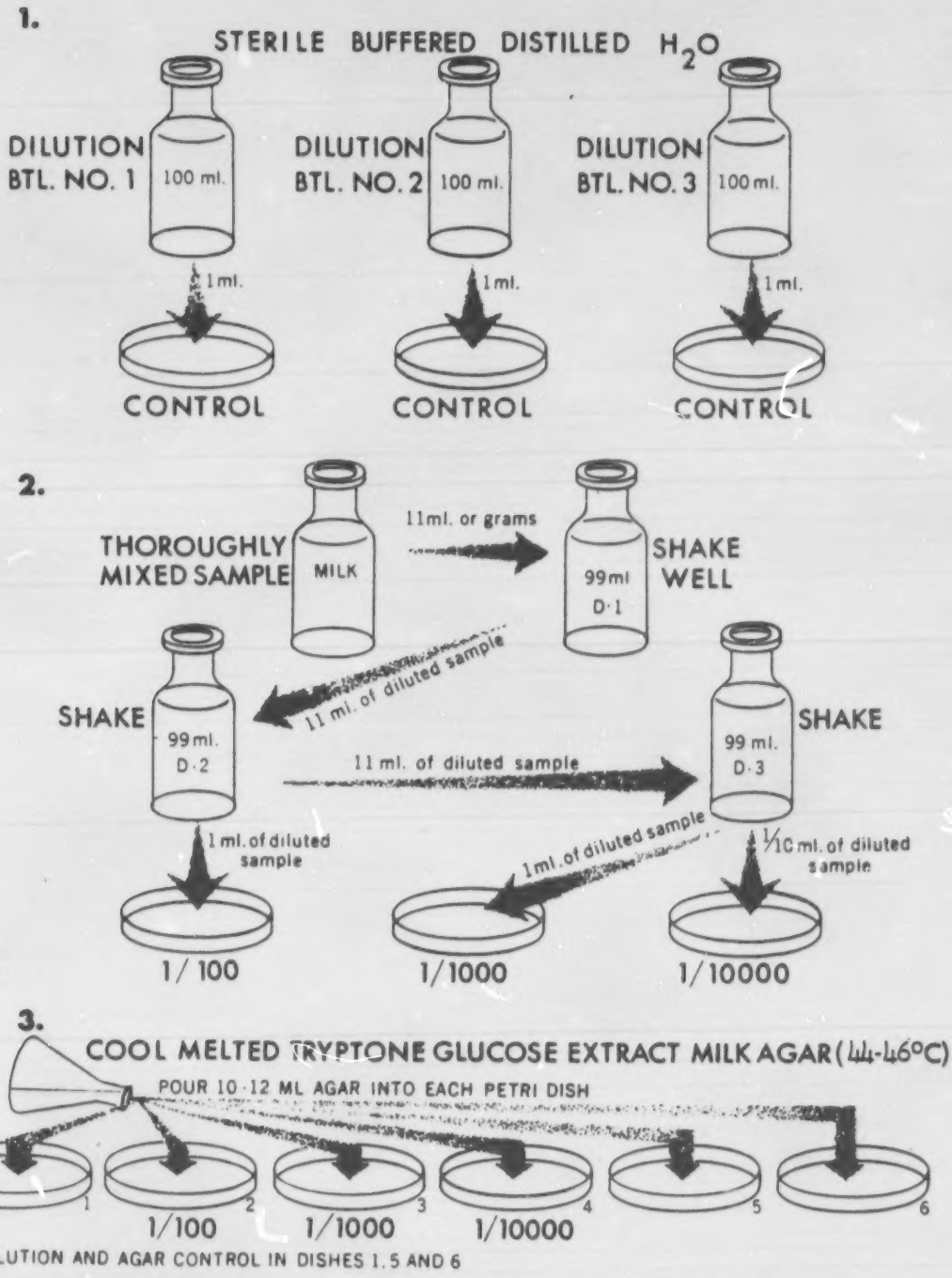


Figure 1 – Steps of Inoculation in Standard Plate Count of Bacteria in Dairy Products.

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DEPARTMENT OF VETERINARY MEDICINE

VETERINARY SPECIALIST

VETERINARIAN

MEAT INSPECTION

1-3

November 1974

SCHOOL OF HEALTH CARE SCIENCES, USAF
SHEPPARD AIR FORCE BASE, TEXAS

Designed For ATC Course Use

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MEAT INSPECTION

OBJECTIVE

The areas of meats and meat products discussed within this text will enable you to perform verification inspections and COLEQUAP examinations on Government meat products.

Completing this unit of instruction will prepare you to:

a. Conduct an inspection and evaluation of Beef, Boneless, Frozen (Fabricated)

b. Conduct an inspection and evaluation of Bacon, Slab or Sliced, Chilled or Frozen

c. Conduct an inspection and evaluation of designated COLEQUAP meat item. The inspection will be based on current Consumer Level Quality Audit Program directives and criteria.

INTRODUCTION

Meat inspection in the veterinary service involves the red meats and meat products of beef, pork, lamb, veal, and calf. This text deals with the slaughter, processing, grading, and inspection of these animals. Animal breeds, anatomy, and the United States Department of Agriculture (USDA) functions are discussed to provide a foundation and a parallel for the student. Each section will expose the student to the general knowledge requirements necessary for veterinary specialist.

Supersedes SW 3ABR90830-IX-1, dated October 1973; HO 3ABR90830-IX/30BR9921-1, dated June 1973; HO 3ABR90830-IX-1/30BR9921-1-III-1b(1), dated October 1973; all of which may continue to be used until existing supplies are exhausted.

SECTION A - ANIMAL SCIENCE

1. Definition - Animal Science is the scientific production of livestock including all phases of breeding, feeding, marketing, and slaughter. The largest end-product of the industry is (red) meat which is the edible portion of domestic animals used for food. There are three meat classes used for red meat production: Bovine (beef), Porcine (swine), and Ovine (sheep).

a. Breeding - A breed is a group of animals possessing one or more distinguishing characteristics and the ability to maintain such characteristics through their offspring. Selection of the proper bloodlines with ideal breed character is important to the production of an animal which yields high percentages of retail meat cuts for consumption. Many breeds have been developed in each species to satisfy a particular purpose and breeds having a group of characteristics which suit them for a particular purpose are called Types.

b. Feeding - Feeding of all species is based on the animals ability to convert feed concentrates and roughage (grass) into edible meat protein. Early maturing animals can obtain a high degree of finish at a profitable margin while slow maturing animals require extended feeding periods. Beef animals require 7-10 pounds of feed for the production of one pound of protein and this along with many factors must be considered. For example, heifers mature faster and reach a given grade sooner although they gain less per day than steers. The heifer can be marketed 30-40 days earlier than steers or they become too fat. Animals must be fed to their individual capacities and certain breeds and individuals show greater overall capacities yielding higher quality carcasses.

c. Marketing - The sale of livestock is big business. There are several methods used according to an individual's bargaining power. Small producers have lesser bargaining power and must take their product to the market. Once at the market the producer is dependent upon an agent to find a buyer and also dependent on the buyer to pay the best price. Small producers must bear the extra cost of a middleman to bargain for them. Larger producers have advantages in greater bargaining power; the market comes to them. The middleman is eliminated and profit margins are increased. Prices and supplies fluctuate and producers must be aware of optimum times to insure highest prices for their product. They must seek the best market and strive for greater profits.

d. Slaughter - The conversion of live animals to meat is the slaughter process performed by meat packers. Meat packers disassemble carcasses and market the wholesale cuts. The packer competes for raw materials and sale of finished products. Meat is very perishable, and is sold rapidly yielding a quick turnover of capital. Many changes have occurred in meat processing due to re-location of large companies, new laws regulating the process, and the quality of animals being offered.

Processors have moved from large cities to areas of livestock production. The Government has established rigid sanitation and wholesomeness requirements through such laws as the Meat Inspection Law. Producers have offered higher quality animals due to increased knowledge of breeding and feeding.

2. Types of Bovine

a. Beef Type Breeds

(1) Angus - A solid black, polled animal originating in Scotland. The Angus is smaller in stature, therefore, lighter in weight compared to other major breeds; mature bulls may weigh 1800 pounds while cows weigh 1200 pounds. They are early maturing animals producing high quality carcasses, having won the most carcass quality championships.

(2) Hereford - Originating in England, the breed has both polled and horned animals. Color pattern is red with white face, switch, underline, crest and white stocking legs. Slightly heavier than Angus, bulls may weigh 2000 pounds and cows 1300 pounds. Hereford are second only to Angus in carcass quality but first in overall popularity.

(3) Shorthorn - A red, white, or roan animal with or without horns. The animals is most popular in crossbreeding needing improvement in carcass quality. The shorthorn originated in England as the Hereford and is the same size.

(4) Charolais - A French breed which appears in various shades of white, horned and hornless. Size is the most desirable characteristic, bulls weighing 2500 pounds and cows 1700 pounds. The gainability of these animals is high to coincide with increased size but increased muscling with small amounts of marbling yields lower quality carcasses.

(5) Brahman - American Brahman are gray, red, and black distinguished by a large crest over the shoulders and loose skin under the neck. Overall size is impressive but the animal does not finish evenly with drooping rumps and little fat deposition. Crossbreeding is used to pass on the Brahman's ability to resist heat and insects.

(6) Santa Gertrudis - The first American breed, resulting from crossing 5/8 Shorthorn with 3/8 Brahman. The large red cattle are naturally horned and produce average quality carcasses. Slow maturity parallels the size of the animal and without the quick maturity, size is a disadvantage.

(7) Other Beef Breeds

(a) Brangus = 5/8 Angus x 3/8 Brahman

(b) Beefmaster = 1/2 Brahman x 1/4 Hereford x 1/4 Shorthorn

(c) Charbray = 5/8 Charolais x 3/8 Brahman

b. Dairy Type Breeds

(1) Holstein - Largest of dairy breeds, black and white in color, either color being predominant. The size of these animals reflects itself in milk production, averaging 10,000 pounds per year. Butter fat is the lowest in content of any major breed, averaging 3.45%.

(2) Jersey - The smallest of the dairy breeds, producing only 6,000 pounds of milk per year. Color is described as fawn with white markings and usually with black areas around the eyes and on the noise. The breed is very popular due to its butter fat content, highest of any breed at 5.0%.

(3) Guernsey - The color is similar to Jersey but white areas are larger. The breed is quite similar to Jersey in many ways being slightly larger in size, producing slightly more milk, and butter fat of 4.5%.

(4) Brown Swiss - As the name implies, these animals are various shades of brown. Brown Swiss are second to Holstein in size but milk production is low with 1000 pounds per year and butter fat averaging 4.0%.

c. Dual Purpose Breeds - The dual purpose breeds originated in England with the idea of producing animals suited for milk and meat production. The concept of beef type was bred with dairy type to result in an animal capable of high yields in each area. The carcass quality is lower than a strictly beef type animal and milk production is low in quantity and butter fat. The most prominent breeds are Red Devon, Red Polled, and Milking Shorthorn.

3. Types of Porcine

a. Reconstruction Theory - Porcine animals have moved forward in production from the "lard" and "bacon" type to the "meat" and "fat" type. Lard was in great demand during early days of swine production, but the trend is now toward meat-type animals. Live animals are 200-220 pounds producing carcasses approximately 70% of live weight. Production of meat-type hogs has given new dimensions to carcass length and backfat thickness. The lengthy carcasses measuring 30 to 31 inches from the aitch bone to the first rib yield larger percentages of retail cuts with backfat measurements being taken over the first rib, the last rib and last lumbar vertebrae, taking an average.

b. Porcine Breeds - Breeds of swine differ as cattle do in the quality of carcasses produced. The swine industry has bred animals to

improve this quality and increase the rate of gain. Breeding is centered around production of longer carcasses yielding higher percentages by weight of retail cuts. General appearance is differentiated by color, ear length and position, and shape of the face.

c. Examples of Porcine Breeds

(1) Duroc - Solid red in color with medium dished face, medium length, drooping ears. Gainability is above average and carcass quality is average.

(2) Hampshire - Black with white belt entirely circling the body, including both front legs. The ears are medium length and erect with a straight face. Rate of gain is average but carcass quality is above average.

(3) Yorkshire - Solid white in color, slightly dished face and erect ears. Rate of gain is excellent and carcass quality is average.

(4) Poland China - Black with white spots, slightly dished face and medium length, drooping ears. Gainability is below average and the carcass is low quality but high in muscling ability.

(5) Chester White - Solid white, medium dished face with medium length, drooping ears. The rate of gain is average and quality of carcasses ranks above average.

(6) Berkshire - Black with white feet, face, and tips of tail. The face is well dished and ears are erect. One of the oldest breeds around with average ratings for gain and carcass quality.

(7) Landrace - A solid white animal which is considered a new breed. Rate of gain and carcass quality are far below average.

(8) New Breeds

(a) Beltsville #1 - 75% Landrace x 25% Poland China

(b) Beltsville #2 - 58% Yorkshire x 32% Duroc x 5% Landrace x 5% Hampshire

(c) Minnesota #1 - 52% Tamworth x 48% Landrace

(d) Minnesota #2 - 40% Yorkshire x 60% Poland China

(e) Montana #1 - 55% Landrace x 45% Hampshire

(f) Palouse - 65% Landrace x 35% Chester White

4. Types of Ovine

a. Breed Variation - Ovine breeds have been bred and developed for economic returns in wool and meat. Meat type breeds, classified as mutton, have developed from improvement oriented breeding, yielding high quality and excellent conformation with medium and long wool types. Wool types are classified as fine wool as a result of breeding attempts to improve wool qualities over carcass quality. Dual purpose breeds have been developed from crossbreeding fine wool and long wool types. Breeding and development are difficult processes which are dependent to a degree, on chance, and this resulted in various combinations of wool and meat types. Breeds exist with high quality wool and low quality carcasses and vice versa. Physical appearance of ovines is dependent upon wool length and conformation or muscling. Color is different only on the face and legs with white, brown, or black dominating. Horns are found in some breeds, predominately on males, other breeds are entirely polled.

b. Ovine Breeds

(1) Wool Types - Fine Wools

Merino
Rambouillet
Debouillet

(2) Mutton Type

Medium Wools	Long Wools
Cheviot	Lincoln
Dorset	Cotswold
Hampshire	Leicester
Shropshire	Romney
Southdown	
Suffolk	
Oxford	

(3) Dual Purpose

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SECTION B - ANATOMY

1. Definition - Literally the term "anatomy" means "to cut apart." The study of anatomy is a science dealing with the form and structure of all organisms. Macroscopic anatomy is referred to as gross anatomy and deals with structures visible to the unaided eye. Microscopic anatomy is referred to as histology and consists of tissues and cells only visible with the aid of a microscope. Our discussion will be limited to gross or macroscopic anatomy for the purpose of inspection. Knowledge of internal and external surfaces and of regional landmarks is necessary to performing ante mortem and post mortem inspections and grading of beef, pork, lamb, and veal. Terms of position and anatomical structure such as cells, tissues, organs, and systems must be understood to inspect carcasses for any of seventy diseases known to be transmissible to man. These terms are also necessary for landmark references in the processing of by-products.

2. Anatomical Terms - The following terms are necessary for an understanding of position and location of parts of the body.

a. Anterior - (cranial) the position toward the head.

b. Distal - the location away from the median.

c. Dorsal - above, over, or upward.

d. Lateral - the side away from the median plane.

e. Medial - toward the median plane.

f. Median - referring to a plane through the vertebral column, which would divide the body into equal halves.

g. Posterior - (caudal) the part of the animal toward the tail.

h. Proximal - the location nearest the median.

i. Ventral - the underside, downward, or below.

3. Structures - Structures, if discussed in order of precedence, are important to our understanding of anatomy. Cells are the smallest unit of an animal body and serve as the starting point of our discussion. Cells will develop into tissues when bound by intercellular substances. Tissues will be specialized and become joined as organs. The organs will be discussed in conjunction with that particular system they comprise.

a. Cells and Tissues - Cells function individually to perform congruent activities of the body such as growth, metabolism, response

to stimuli, contraction, and reproduction. A typical animal cell consists of three main parts; the cytoplasm, the nucleus, and the cell membrane. As cells become specific for particular functions a union of such cells becomes a tissue.

(1) Epithelial Tissue Cells - These tissues form tissues which cover and protect the body, such as, skin, hair, hoods, and feathers. These cells also line body cavities as mucous and serous membranes as well as forming active parts of glands. The primary functions are protection, absorption, and secretion. Serous membranes line closed body cavities; the peritoneum surrounds the abdominal viscera while the pleura surround the lungs of the thoracic cavity. Mucous membranes are found in open body cavities, such as, the digestive tract, from mouth to anus, is lined with a mucous membrane. Skin is found on meat animals for protection, and is often removed during processing as are the membranes.

(2) Connective Tissue Cells - These cells support and bind other tissues together to form tissues and organs. Many types of connective tissues are found within an animal, each specific in consistency and chemical composition for its purpose. Adipose tissue is fatty tissue found intermuscular and intramuscular. Ligament and tendon are white fibrous tissues with separate functions; ligament joins bone to bone and tendon joins muscle to bone. One example of yellow elastic tissue is found on the dorsal surface of the neck commonly called backstrap (ligamentum nuchae). Cartilage is an immature state in bones and can be seen in young animals in such areas as the buttons, sternum, and ribs. Bone is the framework of the skeletal system taking on many shapes to serve its function; flat, long, short, and irregular.

(3) Blood tissue cells - fluid tissue consisting of a fluid matrix called plasma and various cells. Plasma transports the cells through the vascular system allowing each to accomplish its function. Blood is responsible for such work as maintaining body temperature, removing waste, and carrying nutrients. Red blood cells (erythrocytes) are responsible for combining with oxygen and carbon dioxide to transport them in or out of the body. White blood cells (leukocytes) fight infection of the body. There are other cells and functions of blood tissue which are best discussed in the text of physiology (Section C).

(4) Muscle tissue cells - specialize in contracting to move the body and support its posture. Skeletal (striated) muscle is found in connection with bones and forms the majority of an animal used for food. Smooth muscle is associated with systems, such as, in the walls of the digestive tract, blood vessels, urinary, and reproductive organs. Cardiac muscle is found only in the heart and is often called involuntary striated muscle because it is not under conscious control as are the skeletal muscles.

(5) Nerve tissue cells - dictate body activity by conducting impulses through the body. Nerve cells banded together form nerves of several types: the central system nerves (brain and spinal cord); the peripheral nerves, which supply skin and appendages; the motor nerves, which supply muscles of locomotion; and the sympathetic nerves, which provide automatic reflex action.

b. Systems and Organs - Organs are a structural unit of a plant or animal body which serves a specific function and work together to produce systems. Systems combine to create a functional body. Our discussion of systems will include the organs of importance.

(1) Skeletal system - will be divided into axial and appendicular skeleton and joints.

(a) Axial skeleton - Skull, vertebral column, ribs, and sternum.

1 Skull - The skull of the bovine consists of 29 bones; many of these bones are fused. The skull as such is not especially significant in meat inspection, but certain lymph glands within the oral cavity are of importance during inspection. Brains found within the protection of the skull are an edible by-product. The skull is covered with muscle commonly called "head meats", which goes into sausage products.

2 Vertebral Column - Consists of irregular bones (vertebrae) extending from the skull to the tail. It acts as a beam in supporting the animal body. The vertebrae surround the spinal nerve cord and are divided into five regions.

a Cervical (C) - Cattle have seven of these vertebrae; these are the first vertebrae in the vertebral column, referred to as neck vertebrae.

b Thoracic (T) - Cattle have 13 of these; each vertebrae has a rib attached.

c Lumbar (L) - Beef cattle have six of these; they are in the region of the loin.

d Sacral (S) - There are five of these vertebrae; collectively, they are called the sacrum.

e Coccygeal (Cy) - Commonly called tail vertebrae, there may be from 18 to 21 of these in cattle. Of the animals which we will study, the vertebral formulae show the greatest variation in numbers of vertebrae among the coccygeal vertebrae.

3 Vertebral formulae - Vertebrae are useful landmarks for learning cuts of edible meats or inspection points. Learn the vertebral formulae for the bovine, porcine, ovine, poultry, and canine. These formulae are expressed by capitalizing the initial letter of the word designating the number of vertebrae. The coccygeal vertebrae are exceptions to this practice. They are expressed as Cy.

a Bovine - $C_7T_{13}L_6S_5Cy_{18-21}$

b Porcine - $C_7T_{14-15}L_{6-7}S_4Cy_{20-23}$

c Ovine - $C_7T_{13}L_{6-7}S_4Cy_{16-18}$

d Poultry - $C_{14}T_7L\&S_{14}Cy_6$

e Canine - $C_7T_{13}L_7S_3Cy_{20-23}$

4 Ribs - Long, curved, somewhat flattened bones which junction (articulate) with thoracic vertebrae. Cattle have 8 pairs of sternal ribs and 5 pairs of asternal (floating) ribs.

5 Sternum - The breastbone; it consists of seven bones called sternabrae. They are separated by cartilages in the young animal, but are fused into solid bone in the older animal.

(b) Appendicular skeleton - bones of the limbs (hindleg and foreleg).

1 Bones of Foreleg:

a Scapula (Bladebone) - A flat bone which lies on the lateral anterior surface of the thorax.

b Humerus (Armbone) - A long bone which articulates with the scapula and the radius.

c Radius and Ulna (Forearm) - Two long bones which articulate with the humerus and the carpus. The ulna projects dorsally and posteriorly to form a prominence called the elbow.

d Carpus (Knee) - Six bones arranged in two layers; it is the anatomical division between the foot and the leg. This group of bones is comparable to the bones in the wrist of man.

e Metacarpus (Shinbone) - A long bone which articulates with the carpus and phalanges. The distal epiphyseal joint (break joint) is cartilaginous in lamb and ossified in mature sheep.

f Phalanges (Digits) - Six phalanx bodies and six sesamoid bones. The third phalanx forms the hoof in the horse. It is comparable to your middle finger. The other phalanges are comparable to the bones in your hand.

2 Bones of Pelvis and Hindleg:

a Pelvis - Three pairs of flat bones which are fused; the ilium, ischium, and pubis. The pubis is the middle part of the pelvis. The fusion of this middle portion is called the symphysis pubis. When a carcass is split in the middle, the symphysis is exposed and this bone is called the aitchbone. The aitchbone is an important landmark in inspection methods, such as sex determination and proper cutting methods.

b Femur (Round or Thigh Bone) - A long bone which has a proximal articulation with the pelvis and a distal articulation with the patella (kneecap) and the tibia.

c Patella - Shaped like a sesame seed. It articulates with the femur and tibia. This anatomical area is known as the stifle joint (or kneecap in man).

d Tibia - This bone has a proximal articulation with the patella and the femur, and a distal articulation with the tarsus.

e Fibula - A long slender bone located laterally to the tibia. It does not articulate with the femur.

f Tarsus - Consists of five to seven short bones located directly below the tibia. It forms the hock joint and is comparable to the ankle in man.

g Metatarsus - Located below the hock joint; it is comparable to the metacarpus of the front leg.

(c) Joints - The places of union between two or more bones. Joints are movable and immovable.

1 Movable Joints

a Ball and Socket Joints - In these joints, the rounded end of one bone is received into the socket of another. The hip joint is an example.

b Hinge Joints - In a hinge joint, the movement of one plane up in another is permitted. The knee joint is an example.

c Pivot Joints - In this type of joint, one bone rotates around a stationary bone. The joint between the first and second vertebrae is an example.

d Gliding Joints - In this type of joint, there is a sliding of one bone over the other, but there is little motion. The tarsus of the hind leg is an example.

2 Immovable Joints - These joints are fixed articulations with no movements. The bones are held together by a fibrous substance called sutural ligament. The suture joint of the skull is an example.

(2) Muscular System - Muscles are highly specialized organs which have the property of contracting when they are stimulated. Three types of muscle tissue exist; striated voluntary (skeletal) muscle, smooth (involuntary) muscle, and cardiac (involuntary striated) muscle. These types are classified as voluntary (under conscious control) and involuntary (not under conscious control).

(a) Striated muscle - Consists of long fibers with cross striations and a peripherally located nucleus. The cell membrane is called the sarcolemma and is responsible for the texture (tenderness or toughness) of a muscle. Each muscle fiber has its own nerve supply for receiving stimuli in order to contract. Once stimulated the fibers contract to the maximum of their ability, known as the "all-or-none" principle. Striated muscle tissue and some connective tissue comprise the flesh of meat-producing animals.

(b) Smooth muscle - Located in the walls of the digestive tract, reproductive, vascular, and urinary systems these fibers contract slower than striated fibers and respond to various stimuli. The shape is spindle-like and each cell has a centrally located nucleus.

(c) Cardiac muscle - Characterized by modified muscle cells called Purkinje's Fibers which conduct impulses within the heart much as nerves do throughout the body. The heart functions to a spreading contraction wave on an involuntary basis.

(d) Muscle Anatomy

1 Origin - The point where the muscle is anchored; it consists of a short tendon which is attached to a bone.

2 Belly or Body - The midportion and largest part of a muscle; it consists of many fibers and bundles of fibers.

3 Insertion - The other end of a muscle attachment; action is applied at this point to produce motion.

(e) Important muscles

1 Extensors and Flexors - Responsible for mobility of the animal. One is responsible for producing a motion and the other produces an opposite motion.

2 Abdominal muscles - These muscles are important in supporting viscera, in respiration, and in expelling feces.

3 Diaphragm - A structure which separates the abdominal and thoracic cavities. When the diaphragm contracts, air is inhaled into the lungs; when it relaxes, air is exhaled. Since early deterioration may begin under the diaphragm, this muscle is an important landmark in checking the condition of meat carcasses.

(f) Tough and Tender muscles - The more use a muscle receives the larger, tougher, less palatable, and less valuable it becomes. The number of muscle cells never increases only the size of these cells, consequently, as muscles become larger more connective tissue will be deposited within muscle groups, making that particular muscle tougher.

1 Tough muscles - Some examples are outside round, shank meat, and chuck meat which contain more connective tissue.

2 Tender muscles - Loins and inside rounds are more valuable and contain less connective tissue.

(3) Nervous System - The nervous system is the governing and controlling system of the body. There are two kinds of nerve fibers. Those which enter the dorsal root of the spinal cord are the sensory nerves which carry impulses to the central nervous system. The motor nerves enter the ventral root and carry motor impulses to all parts of the body.

(a) Central System - The function of this system is to receive and interpret information from the sensory nerves. The brain and spinal cord are the components of this complex system of nerve fibers. The complexity is best seen through realizing that 50,000 individual nerve fibers enter the base of the brain in an area less than 1/2 inch in diameter.

(b) Peripheral System - Provides a means of communication from the environment (externally and internally). Stimuli are received by receptor organs of the central nervous system and transferred from the central nervous system to the proper effector organs in the body, muscles or glands. It is composed of all nervous structures outside the brain and spinal cord. The spinal nerves are arranged in pairs in accordance with their location, such as, cervical, thoracic, lumbar, sacral, and coccygeal.

(4) Digestive System - Our discussion will be limited to the bovine system (ruminant system), as it is the most complex. The system includes the alimentary canal which runs from the mouth to the anus, and the accessory organs (the salivary glands, liver, pancreas, and gall bladder). In this system, both mechanical and chemical processes take

place to make food usable by the body. The mechanical actions are chewing, swallowing, regurgitation, peristalsis (alternate contraction and relaxation), and defecation. The chemical reactions result in a breakdown of foods by gastric juices and enzymes to make them usable by the cells of the body. The following structures play a part in the breakdown of ingested foods.

(a) Mouth - The main function of the mouth is prehension (grasping) and mastication (chewing) of food. The teeth and tongue help in both functions. The age of a bovine can be reasonably determined by certain characteristic changes which occur in the animal's teeth. The bovine has a dental formula for its permanent teeth. This formula is:

$$a\left(I\ \frac{0}{4}\ C\ \frac{0}{0}\ P\ \frac{3}{3}\ M\ \frac{3}{3}\right) = 32$$

The letter "I" signifies incisor (cutting teeth), "C" signifies canine teeth, "P" signifies premolar teeth, and "M" signifies molar teeth.

(b) Salivary Glands - Three pairs of well-defined glands are located in the cranial region of domestic animals.

1 Parotid - The largest gland, located ventral to the ear along the caudal border of the mandible (jaw bone). It is composed of serous tissue.

2 Mandibular - Located ventral to the parotid gland, composed of serous and mucous tissues.

3 Sublingual - Ventrally located along the lateral surface of the tongue near the floor of the mouth. This gland is also a mixed gland composed of mucous and serous tissues.

(c) Pharynx - A canal which leads from the nose and mouth to the esophagus. When food is about to be swallowed, the tongue pushes it back, the larynx is closed by the epiglottis, and the food is passed into the esophagus.

(d) Esophagus - The structure through which food passes from the mouth to the stomach. Food is moved downward by rhythmic contraction of the muscular wall of the esophagus.

(e) Stomach - The true glandular stomach is preceded by three divisions (forestomachs) in which food is soaked and partially digested by microorganisms before passing through the digestive system.

1 Rumen - Consist of a dorsal and ventral sac which extend from the diaphragm to the pelvis. The mucous membrane lining is glandless and much bacteria oriented digestion takes place here.

2 Reticulum - Honeycombed in shape, it lies against the diaphragm and liver and communicates with the rumen. The location of the reticulum places it directly ventral of the heart, so any foreign objects such as wire or nails that may be swallowed tend to remain in the reticulum and are in good position to puncture the heart.

3 Omasum - Communicating with the reticulum and abomasum, it is located to the right of the rumen and reticulum and posterior to the liver. The omasum contains blunt papillae which grind roughage before it enters the abomasum.

4 Abomasum - The true stomach located ventral to the omasum. Cell structure changes to glandular secreting mucus which prevents digestive juices from digesting the stomach lining. The glands found within the abomasum correspond to those of a non-ruminant stomach while the glands of the forestomachs are similar to the esophagus of a non-ruminant.

(f) Small Intestine - The small intestine in the bovine is about 130 feet long. It has three parts; the duodenum, jejunum, and ileum. Secreted digestive juices are passed into the small intestine from the pancreas, liver, and gallbladder. The bile which is excreted from the gallbladder converts raw fats to glycerol and fatty acids. The pancreatic juice from the pancreas aids in the digestion of protein and carbohydrates. Absorption of fluids from the small intestine takes place through villi (small projections from the inner lining of the intestine).

(g) Large Intestine - The ingesta are passed from the small intestine to the large intestine. Between these intestines and projecting from the large one is the cecum, where further breakdown of food occurs. The large intestine is about 35 feet long. Liquids which are not absorbed in the small intestine are absorbed in this intestine.

(h) Accessory Organs - The glands that aid in digestion or secretion of digestive fluids which aid in the breakdown of food.

1 Liver - Secretes bile which is stored in the gallbladder, it converts sugar to glycogen for storage and it changes waste products to urea for elimination by the kidneys.

2 Pancreas - Secretes insulin which controls sugar in the body; it is also secretes pancreatic juice, which digests protein, carbohydrates, and fat.

(5) Circulatory System - The basic components are a heart which pumps blood through a system of vessels. The vessels carrying blood away from the heart are arteries and those carrying blood toward the heart are veins. The lymphatic system of lymph fluids is a subsidiary of the blood system working on a smaller scale.

(a) Heart - Consists of four chambers. It is divided vertically in the middle by a septum, and is divided horizontally into upper and lower halves. A fibrous tissue called the pericardium surrounds the heart. Structures of the heart wall consist of the outer layer, which is called the epicardium, the middle or muscular layer, which is called the myocardium, and the inner layer, which is called the endocardium. Tissues which make up the valves between the artia and the ventricles are from the endocardium.

(b) Blood Vessels

1 Arteries - The vessels which carry the blood to tissues and organs. The walls have muscular coats and can withstand pressure exerted by the heart. The arteries branch into smaller vessels called arterioles.

2 Capillaries - Tiny extensions of arterioles (small arteries) and venules (small veins) which form a network in the tissues. They are of a one cell layer which allows for an exchange of oxygen and carbon dioxide between blood and tissue cells.

3 Veins - Veins are thin-walled vessels which carry the blood the heart from the tissues and organs. They have valves which prevent the backflow of blood.

(c) Blood Systems

1 Pulmonary - In the pulmonary system, the blood is passed from the right ventricle through the pulmonary artery to the lungs for oxygenation. The oxygenated blood is returned through the pulmonary vein to the left atrium.

2 Systemic - This system receives oxygenated blood from the left atrium to the left ventricle. The blood is pumped to the dorsal aorta and its branches to the tissues of the body. The venous blood is returned from tissues and organs to the right atrium of the heart.

3 Portal - This system drains blood from the digestive tract and carries it via the portal vein to the liver. The blood leaves the liver via hepatic veins and returns to the right atrium of the heart via the inferior vena cava.

(d) Lymph - Lymph fluid contains cells and is very similar to plasma of blood. It is derived from blood. Lymph carries food to individual body cells and removes their wastes. Another function attributed to lymph is that of combating infection. Lymph does this by carrying infectious material to the lymph nodes.

(e) Lymph Vessels - There are superficial lymph vessels which collect lymph from the skin and subcutaneous tissue, and there are deep lymph vessels which collect lymph from deep tissues. An intricate system of lymph vessels can be found in nearly every part of the body except in muscle fibers, nerves, and blood vessels. The flow of lymph through vessels is influenced by differences in pressure, by muscular movements and by the presence of valves which limit flow to one direction.

(f) Lymph Nodes (Glands) - Nodes are generally oval-shaped and are located along the course of lymph vessels. When lymph enters the node, foreign material is removed and lymphocytes (lymph cells) are added. Pathogenic organisms, such as those which cause tuberculosis, are removed in the lymph nodes. This is the reason lymph nodes are closely checked during meat inspections. A close examination of lymph nodes can reveal tuberculosis and other abscess-forming diseases.

(6) Respiratory System - Among the vital requirements of animals is oxygen supplied by the respiratory system. The life of an animal without oxygen is measured in minutes. The primary functions are supplying oxygen and removing carbon dioxide. Secondary functions are temperature control, elimination of water, and voice production. Lungs are the primary constituent with passages called nostrils, nasal cavity, pharynx, larynx, and trachea which supply and relieve the lungs.

(a) Nostrils - These external openings are seen as part of the muzzle. The muzzle is covered with hair and tubular (sweat) glands.

(b) Nasal Cavities - These cavities are separated ventrally from the mouth by the hard and soft palates. The lining is a vascular mucous membrane which warms the inspired air.

(c) Pharynx - Serves as a passage for both food and water so that air cannot be inhaled similtaneously with food being swallowed.

(d) Larynx - The control valve for air entering and leaving the trachea. It consists of cartilage rings which control voice production and form the Adam's apple in humans.

(e) Trachea - This noncollapsible cartilage continues from the larynx to the lungs where it breaks down into two bronchi, one for each lung. Bronchi branch into bronchioles which communicate with the alveolar ducts and their capillaries for the exchange of oxygen and carbon dioxide.

(f) Lungs - The lungs are very light in weight with a specific gravity less than that of water. Regardless of the thoracic cavity position (contracted or expanded) the spongy-like lungs fill the cavity completely. Once an animal has taken one breath the lungs will

never completely collapse. The diaphragm acts to increase the size of the thoracic cavity during inspiration by pushing (contracting) against the viscera and relaxing to allow expiration, decreasing the size of the thoracic cavity. Enlargement of the thoracic cavity causes an influx of air to the lungs, increasing their size. Air is handled within the alveoli in conjunction with the tiny capillaries and gaseous exchange results.

(7) Uro-genital System

(a) Urinary Tract - The primary responsibility is filtration of waste and water from the blood and selective reabsorption of water and nutrients from the filtered material.

1 Kidney - The kidneys are characterized most by variations in shape. The bovine kidney is lobulated into approximately twenty lobes while porcine and ovine kidneys are bean-shaped without divisions. Each animal has two kidneys located just ventral to the first few lumbar vertebrae. The kidneys and the surrounding fatty tissue are referred to as the kidney knob.

2 Ureters - A muscular tube which moves urine from the kidney to the bladder.

3 Bladder - This hollow muscular organ is used for storage of urine. The empty bladder lies on the floor of the pelvis and as the contents increase the organ moves into the abdominal cavity. The contracted empty condition finds thick cell walls in evidence and as relaxation occurs the walls become thinner, expanding for larger volumes.

4 Urethra - Striated muscle encompasses this tube from the bladder to the external opening. The length and position vary with the sexes. In male animals it runs parallel to the sperm ducts, musculature of the penis, and additional vascular supply.

(b) Reproductive Tract

1 Female - The female has a complex task in reproduction involving the entire body, but more specifically, the reproductive system. The system has two ovaries which release ova to be carried into the fallopian tubes for passage into the uterus. Fertilization occurs within the distance between the ovaries and the uterus. If fertilized, the ova develop within the uterus and pass out through the vagina and vulva.

2 Male - The urethra of the urinary system is also used for a passage by the reproductive system. The testes produce the male sex cells (sperms) within the confines of a scrotum. The scrotum provides the optimum environmental conditions (lower temperatures) for

the testes to produce sperm. The epididymis and vas defrens from each testicle carry sperm to the urethra, which is contained within the penis, for removing sperm to the ultimate goal; the uterus. Accessory glands which add to the sperm contents are the seminal vesicles, prostate, and the bulbo-urethral glands.

SECTION C - PHYSIOLOGY

1. Definition - Physiology is the study of functions of the animal body or any of its parts. Anatomy tells us how the various cells organize and specialize to form the structures within the body. The chemical processes which take place within these structures are the subject of physiology. Physiology of all the systems is complex and those systems which may be used during an inspection to indicate disease will suffice. An inspector's job is to recognize the abnormal reactions and subsequent conditions of the various systems, which would indicate disease. The more important functions of the body provide energy, transport nutrients, combat bacterial invasion or disease, and remove waste. Those systems which chemically accomplish such task are the vascular, lymphatic, and renal. The process which provides energy for the body, by combusting nutrients, is called metabolism.

2. Metabolism - Metabolism may be defined as a chemical change of a material under the influence of living cells. The change may be of an anabolic (constructive) type or of a catabolic (breakdown) type. The types of metabolism we will consider are the metabolisms of protein, fats, and carbohydrates.

a. Proteins - Most proteins eventually become a part of a new tissue, a hormone or an enzyme and can be classified as regulatory or structural proteins. Hormones and enzymes regulate various functions of the body, such as germ cell production and protein breakdown. The structural proteins become part of the individual cells, forming tissues such as muscle. Protein molecules are composed of many amino acids and the breakdown of this complex molecule into various amino acids is a function of metabolism. In the digestive tract, proteins are hydrolyzed (broken down through reaction with water) into amino acids. The amino acids are absorbed by the portal circulatory system and transported to the liver. Additional metabolism may take place within the liver, breaking down the amino acids into various combinations of nitrogen, carbon, hydrogen, and oxygen. One process called deaminization is the removal of the amino radical (NH_2), yielding urea and a carbon-hydrogen product which may be built into individual cells. Another form of deaminization gives the amino radical, water, and energy. The versatility of amino acids allows the carbon-hydrogen product to become hormones, salts, pigments, or catalyst.

b. Fats - Equivalent amounts of fats are two and one quarter times higher in energy than proteins and carbohydrates. Fats are composed of

carbon, hydrogen, and oxygen, as are carbohydrates, but the proportions of oxygen are much less. Fats may be formed from carbohydrates and proteins, especially in animals on carbohydrate-rich or low fat diets. The amount of energy released from fats is high because of the rapid oxidation (energy release) process. Since fats contain little oxygen, oxidation occurs at a greater degree and more energy is released. An enzyme called lipase hydrolyzes fat molecules in the digestive tract, yielding glycerol and fatty acids. These two products combine with bile secreted by the liver to form a water-soluble mixture available for absorption.

c. Carbohydrates - Carbohydrates are the major part of any ration in meat animals and consequently are the main source of energy. The primary functions of energy supplied by carbohydrates are body maintenance, growth for tissues such as meat and wool, reproduction, and production of animal products such as milk. The maintenance energy supplies muscle action for mobility, blood circulation, and movement of food. Most energy from carbohydrates is not used immediately, but is stored by conversion to fat. The composition is carbon, hydrogen, and oxygen with the amounts of carbon varying, hydrogen and oxygen are in the same ratio as in water (H_2O). The breakdown of carbohydrates is divided into fibers, which are not easily digested (plant cellulose) and nitrogen free extracts, such as starch and sugar that are excellent energy sources.

d. Nutrient Utilization in the Cell - Most nutrients providing energy for the body are oxidized or burned inside individual cells. The oxidation is promoted by specific enzymes within each cell at body temperatures. Such breakdown involves a sugar or fatty acid being divided to yield energy, water, and carbon dioxide. The carbon dioxide and water are waste, with the exception of a proportion of water being retained for body maintenance. The energy is stored as an intermediate compound for later use, for example, a steer on full feed would deposit energy as fat molecules.

3. Vascular System - The primary constituents are blood cells and intercellular tissue called plasma. Blood cells are formed in the red bone marrow of mature animals and also in the liver, spleen, and lymph nodes during the embryonic stages. Cells normally function for three or four months before disintegrating and being removed from the system. The functions of blood are carrying nutrients from the alimentary tract and oxygen from the lungs to the tissue cells, removal of waste, transporting hormones, maintaining a balance of water within the body, equalizing the body temperature, regulating the pH or hydrogen ion concentration, and combating infection or invasion of disease causing organisms.

a. Red Blood Cells (Erythrocytes)- These cells originate from bone marrow and contain hemoglobin, which is a combination of porphyrin, globin, and iron. The presence of hemoglobin allows erythrocytes to combine with oxygen and carbon dioxide. Erythrocytes can absorb oxygen

from the air in the lungs to form oxyhemoglobin. The latter readily releases oxygen to oxygen-deficient cells and the hemoglobin component then returns carbon dioxide to the lungs to be exhausted.

b. White Blood Cells (Leukocytes) - The number of these cells is much less than that of the erythrocytes but the independent movement of these cells, along with their functions, are certainly greater. The variety of functions performed by leukocytes gives rise to numerous types of white blood cells; classified as follows:

(1) Granulocytes - These cells are named and classified for the stained color of the granules in the cytoplasm. In mature animals the cell formation is within the red marrow.

(a) Neutrophils - These granules are phagocytic and serve as the first line of defense against infection. Neutrophils pass through the vessel walls and digest bacteria to destroy them. In the process of digesting bacteria some of the neutrophils dissolve dead tissue in the area forming a semi-liquid material called pus. Abscesses are a result of accumulations of the semi-liquid (pus) from neutrophil activity. Neutrophils are most effective against acute (sudden onset, short course) infections, giving rise to abscesses.

(b) Eosinophils - These cells are only present in great numbers during parasitic infestations or other chronic diseases. Histamines, which are characteristic of allergic reactions, are believed to be present within this component of the blood.

(c) Basophils - Basophils have been seen and identified by staining procedures but the function of these cells is unknown.

(2) Agranulocytes - Granules within the cytoplasm are very few in number. There are monocytes, which are formed in lymph nodes and the spleen, and lymphocytes, which can be formed in lymph nodes, spleen, tonsils, and thymus gland.

(a) Monocytes - As were neutrophils, this group is phagocytic and ingest foreign material (bacteria). The monocytes are called out for chronic diseases such as tuberculosis. Migrating through vessel walls, monocytes enter tissues and become larger phagocytes called macrophages.

(b) Lymphocytes - Cells formed in lymphoid tissue such as the spleen and lymph nodes. They are believed to produce antibodies (an antibody with an antigen, and having the specific capacity of neutralizing or reacting with the antigen) and to fix toxins (render toxins non-effective).

c. Platelets (Thrombocytes) - The primary function of platelets is to assist the clotting mechanism of blood. Platelets adhere to the vessel

wall and themselves in an area of injury to block the vessel somewhat. The ability of platelets to constrict the vessel is also attributed to slowing blood loss. A substance called serotonin present in platelets is thought to be responsible for vascular constriction in areas of injury.

d. Plasma - The constituents of plasma include: serum albumin, fibrinogen, globulin, lipids, cholesterol, hormones, enzymes, and nitrogen materials. As a whole, plasma serves to transport the cells of blood to all parts of the body. The many components of plasma allow it to perform such tasks as clotting to arrest hemorrhage, aid in recovery of disease, and carrying dissolved carbon dioxide.

e. Serum - This portion of blood remains as a liquid after clotting. Antibodies that the animal may have formed are contained within serum and may be useful in prevention and treatment of disease. Immune serums are produced by inoculating an animal with killed bacteria or viruses. Repeated injections into the same animal cause large quantities of antibodies to be produced. The serum from this animal may be injected into an animal susceptible to the same disease and give it passive (temporary) immunity.

f. Action of Lymph - Lymph is tissue fluid which has filtered through the blood capillaries. It contains many white blood cells which are circulated from the tissue spaces through the lymph vessels. Nourishment and oxygen are carried to the tissue cells, and waste products are carried away. Lymph flow begins in the tissue spaces and flows toward the heart through the thoracic duct and right lymphatic duct. When lymph in excess of tissue demands is produced or when lymph is produced faster than the vessels can remove it, a condition known as edema occurs. The primary causes of edema are injury to capillary wall, impairment of drainage, increased capillary pressures and lowered osmotic pressure of the colloids in the blood. The osmotic pressure is the force with which a solvent passes through a semi-permeable membrane. The concentration of colloids (particles which are too large to pass through a membrane) influences the pressure.

4. Renal System - The two kidneys act as blood filters. The liquid of the blood passes through the capillaries and the glomerulus. The glomerulus is a sac which has a coiled loop of blood capillaries in the center and a narrow tubular outlet which connects with the pelvis of the kidney. Components which are still essential to the body may be reabsorbed into the cells lining the tubular outlet. The fluids, with the excreted wastes, are formed in the pelvis of the kidney and are passed to the bladder as urine through a tube called the ureter. The urine is stored in the bladder until urination, which takes place through the urethra.

a. Filtration - Excesses of sugar and wastes such as nitrogen from protein breakdown are removed. The proper acid-base balance in the blood is maintained through excretion and reabsorption.

b. Reabsorption - Water, salts, sugars, and certain protein elements are reabsorbed to maintain a proper balance in the bloodstream.

SECTION D - BEEF INSPECTION

1. The Meat Inspection Law - In early American history, most animal slaughter was done on farms. With the growth of cities and the development of the refrigerated railroad car, shipment of live animals from farms to large cities for slaughter was begun. The meat products were then shipped to other cities in refrigerated rail cars. This change from farm or local slaughter to animal slaughter in the cities reduced the local control over the slaughter and movement of the animals. Such reduced control and a European threat of an embargo against American meats made some form of Federal control over slaughter and movement of animals a necessity. To prevent the severe economic effects of an embargo against American meats, Federal legislation was passed in 1890 to implement hygiene in slaughterhouses which exported meat. After the unfavorable meat scandals of the Spanish-American War (1898) and the publication of Upton Sinclair's book, "The Jungle" (1906), President Theodore Roosevelt conducted a crusade to enact legislation for Federal control over all slaughterhouses which were engaged in interstate commerce. This control came into existence through the Meat Inspection Law on 30 June 1906.

2. USDA - As a result of the Meat Inspection Law, the United States Department of Agriculture (USDA) was established. The USDA functions to insure meat is free of more than seventy diseases transmitted from animal to man. A subdivision of the USDA known as the Animal and Plant Health Inspection Service (APHIS) maintains veterinarian and lay meat inspectors to detect and destroy diseased meats in those plants approved by the USDA. The inspectors actually function in several areas of wholesomeness inspection from plant construction to handling of condemned meats. Products inspected by the USDA, and bearing the proper stamps, are free to move in interstate and foreign commerce. The costs for such wholesomeness assurance is borne by government corporate taxes and income taxes at the approximate rate of 15¢ per person per year or 30¢ per animal.

a. Plant Approval - USDA inspected plants are approved for proper ventilation, adequate lights, and efficient sanitary systems in accordance with plant construction requirements. The plant must also have easily clean, rust resistant equipment and an approved operating technique before approval is granted. If all the necessary requirements are met, the establishment is approved and inspectors are assigned.

b. Antemortem Inspection - USDA inspectors, accompanied by a representative of the plant, check live animals within the holding pens to detect and eliminate those unfit for slaughter. An animal may be totally eliminated and marked "Condemned" for such conditions as fever, diarrhea, difficult breathing, or coughing. Condemned animals are

handled and controlled by inspectors and may be rendered (cook out fat), tanked (fertilizer or animal feed), chemically denatured, or incinerated. Those animals appearing slightly ill, possibly just weak from the trip to the slaughterhouse, are also separated and marked "Suspect". Suspect animals may be slaughtered at the end of a day's production if approved by the inspector. The animals considered wholesome are marked "Passed" and slaughtered.

c. Postmortem Inspection - The animals that are accepted for further processing for human consumption receive a thorough postmortem inspection. The carcass, head, and viscera are closely examined for physiological signs of disease or abnormal conditions, such as abscesses. The USDA inspector has the authority to condemn meat during any stage of processing and to order the correction of unsanitary conditions throughout the establishment. Unfit carcasses are stamped "Condemned" and removed from the processing area, while others are stamped "Passed". Condemnation can be partial or complete, depending upon the type and severity of the disease; for example, complete condemnation is in order with anthrax and blackleg, while partial condemnation may suffice with tapeworms or bruises. Should unsanitary conditions develop in any area, the inspector places a "Rejected" or "Retained" tag on the equipment or area. The tag is removed by the inspector only after cleaning and reinspection of the area.

d. Products Inspection - Surveillance is maintained throughout all aspects of cutting, boning, grinding, curing, cooking, and smoking. Each process is carefully examined for sanitation and proper handling. Temperatures are important in preventing spoilage, bacterial growth, or insuring proper cooking. Ingredients and additives are approved and checked for each product by the inspector. Raw materials used must be wholesome and the end product must reflect this characteristic. The inspector has the authority to reinspect any item that may become sour or rancid during processing or holding. Wholesomeness is the inspector's primary goal and all possible points of contamination are his concern.

e. Proper Labeling and Laboratory Control - Inspectors use seven laboratories to analyze meat products under the "US Retained" tag. All ingredients must be safe for consumption (nontoxic) and be in amounts specified. Packaging and packing material must also be nontoxic. Adulteration is a constant concern during processing to guard against excess fat and moisture, the use of foreign species such as horse meat, or inclusion of insecticides, antibiotics, and estrogenic residues. Prior to using additives in meat products, approval is granted by the USDA according to criteria set under the Food, Drug, and Cosmetic Act. Additives which are acceptable and the specified amounts are listed by the USDA and only those appearing within this list may be included in a product. The labels are approved and verified to assure the name of the product, ingredients (in descending order of contents), weight or quantity, and the inspection legend. Ingredients are the most important area on the label and USDA inspectors must draw samples for laboratory analyses to insure proper labeling.

3. The Wholesome Meat Act - The passing of The Wholesome Meat Act, 15 December 1967, allowed the military to procure from state inspected plants. This law directs all state inspection systems to become "equal to" or more stringent than the Federal (USDA). To be eligible to sell their products to the U.S. Armed Forces, state inspected establishments must have consumer health protection and safeguards that equal those provided by the Federal inspection systems. The state inspection system is evaluated and approved by the USDA, inspectors are assigned, and contracts are awarded. Products from state inspected meat establishments can now be exported or shipped across state lines and in foreign commerce. One additional requirement is made by the military, any plant being considered for a contract must certify compliance with Public Law 85-765 (Humane Slaughter Act), 1 July 1960. This law simply states that meat sold to the Federal government must be slaughtered humanely.

4. Military Inspection in CONUS - Class 3, origin inspections, are accomplished on USDA approved meat establishments. The USDA inspector will continue to provide wholesomeness inspection through antemortem and postmortem surveillance as well as sanitary inspection of the plant. The veterinary service will inspect products such as Beef Roasts, and Steaks, Boneless, Frozen, for contract and specification requirements. Although origin inspections are limited, it is important to note the function of the veterinary service is contract compliance. Any meat product is subject to origin inspection if deemed necessary to insure a product comparable to that specified within a contract. The veterinary service assumes the responsibility of protecting the financial interest of the government by thorough origin inspections, insuring the product produced and shipped is the product paid for.

5. Military Inspection Overseas - In overseas areas, the veterinarians of each major overseas command are responsible for providing and enforcing sanitation standards for slaughtering establishments and for directives for the reporting of diseased or otherwise unsound carcasses. This provision is necessary to assure that unfit products are not accepted for military use. To fulfill such responsibilities requires the command veterinarian to exercise control over antemortem and postmortem inspections. This control is accomplished by providing military personnel to perform or supervise such inspections. Guidelines are set for military inspectors within the "Manual of Meat Inspection Procedures of the USDA", and MIL-STD 1481, "Sanitary Standards for Meat Processing Plants in Overseas Areas." Normally, only those plants approved for exporting meat products to the United States are used for military procurement overseas. Additional duties are required of the veterinary service overseas because there is no USDA. Such duties as antemortem, postmortem, routine sanitary inspections, laboratory analyses, examining products (during and after preparation) which are being prepared for military procurement, and examining the vehicles transporting such products to military installations.

SECTION E - ANIMAL SLAUGHTER AND GRADING

1. Meat - Meat is the edible portion of domestic animals used for food and one purpose of the three meat classes; bovine, porcine, and ovine, is to provide meat. The slaughter process produces carcass meats and variety meats from the meat classes. Carcass meats are composed of muscle, connective tissue, fat, water, bone, skin, nerves, and blood vessels. The edible organs and glands of the animal are considered variety meats, such as, liver, kidney, heart, brains, tongue, and stomachs. Meat packers are responsible for producing carcasses from live animals and separating carcass meats and variety meats for further processing.

2. Meat Processing Sequence - Meat is produced by live animals as muscle and the slaughter process converts this muscle into meat, by separating the edible from the inedible. The principles of the disassembly process are: separation of fat from lean, tough from tender, valuable from less valuable, and thick from thin.

a. Holding - Animals should rest with access to water and be denied feed for twelve to twenty-four hours. Rest should be without excitement or stress, causing frightened movement of the animals. If such precaution is followed, animals are easier to eviscerate, bleed more completely, produce brighter colored meat, and are easier to skin.

b. Stunning Methods - The Federal Humane Slaughter Act established three acceptable and humane stunning methods. The following methods are presently used to immobilize the animal and initiate a state of unconscientiousness so the animal does not suffer death.

(1) Mechanical - The mechanical method, using a cash bolt pistol, crushes the skull along the median plane just dorsal of the eyes. The skull is thin in this area and fragments are lodged into the anterior cerebrum of the brain immobilizing the animal. The medulla oblongata, located posteriorly in the skull, regulates heart function and remains operable, aiding in bleeding the animal.

(2) Electrical - The electrical method is used mostly on swine. Approximately 90 volts for 2 to 10 seconds on the forehead, will leave the animal unconscious and allow complete bleeding.

(3) Chemical - The chemical method makes use of large concentrations of carbon dioxide gas for 50 seconds in a closed tunnel. This method suffocates the animal and will allow 20 seconds for initial sticking.

c. Sticking-Bleeding - Bovine and ovine animals are severed from the sternum to the lower jaw causing hemorrhage of the carotid artery and jugular vein. It is common practice to reach into the anterior thoracic cavity and also sever the aorta (carries blood away from the heart) to

allow more rapid bleeding. Porcine animals are stuck for only the length and width of the knife just anterior of the sternum. The opening is small, but due to the additional processing step of scalding (to loosen hair), this is necessary to prevent contamination from the water. All species are allowed to bleed for 6 to 9 minutes prior to severing the medulla oblongata to insure complete bleeding. However, the medulla oblongata must be severed before further processing to insure total death. The quantity of blood expected is 30 pounds in bovine, 5 pounds in ovine, and 7 pounds in porcine.

d. Removal of Shanks (Shanking) - The shanks are removed during the same time as the head, before moving out of the bleeding area. The foreshanks are removed in the carpal joint, distal to the radius and ulna. The hindshanks are severed in tarsal joint distal to the tarsus or hock. The tarsus must remain because it serves as a point of attachment for the gambrel tendon which is used to suspend the carcass from the rail.

e. Removal of the Head - The head is skinned, then removed at the first vertebral joint. Each head must be tagged to identify it with the carcass and washed. The parotid, suprapharyngeal, and mandibular lymph glands are incised by the USDA inspector to check for disease. Good indication of disease is off-color, bloody, swollen, or abscessed conditions. The masseter (chewing) muscle is also incised to check for tapeworm cysts which would cause rejection of the head and the tongue is inspected for abnormal conditions, such as thorns. The head will remain on the inspection rack until the carcass and viscera are inspected and passed.

f. Removal of Hide, Hair, and Pelt - Skinning the animal is important and requires skilled personnel. Care must be taken to prevent cutting or mutilating the external muscles while removing the skin. The skin, specifically the hide, is more valuable as a by-product without holes or cuts. The carcass is devalued also by cutting or mutilating the surface taking away from the overall apperance. Bovine and ovine animals are skinned in such a manner that the external fat covering allows some room for error. Skinning is also easier in these animals due to the carcasses being hot. Porcine animals are skinned during boning and there is a large external fat covering to work with, but the fat is hard from being chilled.

(1) Bovine hides are removed primarily by pneumatic hide pullers. The skin is released on the shanks, neck, and brisket by hand and the animal is made stationary while the hide is pulled off. Some cutting is required on either side to prevent tearing of the external muscle, but the external fat covering allows cutting to some degree without showing in the finished product.

(2) Ovine animals have a membrane covering the external muscle called the fell membrane which must be left on the carcass. This parchment-like membrane preserves and retains moisture in the carcass during chilling. The pelt (skin and wool) is released with a knife on

the shanks, neck, and brisket. The remainder of the pelt is removed by forcing the fist between the fell membrane and the pelt, preserving the fell membrane.

(3) Porcine animals are processed much the same as bovine or ovine except during skinning. The hair is loosened by scalding the animal in hot water (160°F) for 3 to 4 minutes. Removal of hair is accomplished by a set of rotating flexible paddles, beating the already loosened hair out. The skin remains on the carcass until fabrication into retail market cuts.

(4) During the interim of time between heading and skinning, two important ties are made. The head is relieved of the esophagus and trachea and to prevent the digestive contents from escaping, the esophagus is tied. As the hide is released from the hindshanks and rump area, the rectum is loosened. This area of the alimentary tract is called the bung and also is tied off to prevent escape of the digestive contents.

g. Evisceration - Examination of the visceral and body lymph nodes, the organs of the viscera, and the exposed portions of the carcass are accomplished during this process. Carcasses are suspended by the gambrel tendon on the hindleg from the start, and evisceration also takes place from this position. The incision is made on the ventral median plane from the posterior to the anterior end. The abdomen is completely opened with a knife and the sternum is split with a power saw. The thoracic viscera are separated from the abdominal viscera immediately after removal. In addition to the previous ligations made at the esophagus and rectum, the duodenum (small intestine) must be tied at both ends to prevent the contents from escaping. The bronchial lymph nodes are incised and the lungs are checked for pneumonic conditions or cysts infestations. The heart and lungs are examined for cysts and the heart is opened for further inspection. The remainder of the abdominal contents are inspected by examining the mesenteric, portal, and renal lymph glands. The most obvious and frequent cause of rejection or condemnation is fecal or dirt contamination and abscesses resulting from numerous diseases.

h. Splitting and Washing - The carcass is inspected for wholesomeness just prior to being split into sides (equal halves) and will be removed before splitting if marked "Condemned". If the carcass is inspected and passed, it will be halved along the vertebral column exposing the chine bones. Splitting is most conveniently accomplished in the slaughter area and also aids in rapidly chilling the carcass. Washing is necessary at this point to remove bone residue, blood drippings, and any extraneous material.

i. Shrouding - Shrouding beef is simply covering the exterior surface of a side of beef with heavy muslin. The cloth is wrung out in either plain hot potable water at a temperature of 120°F to 125°F, or a 20 percent potable hot salt water (brine) solution at a temperature of about 115°F. These shrouds are held in place by large wooden or metal shroud

pins, and remain on the sides of beef until the beef is completely chilled. Chilling time will vary with the size of the sides, but usually lasts from 12 to 24 hours.

(1) Plain Shroud - The primary purpose of shrouding is to reduce moisture loss known as shrinkage. Normal shrinkage is approximately 3 percent for unshrouded sides, and for shrouded sides, the moisture loss is only 1 to 1 1/2 percent. Since the shroud is pulled tight around the external surface, it improves the appearance by molding the fat and absorbing excess blood. The cover provided by the shroud prevents external contamination.

(2) Salt Water Shroud - The primary motive of salt water shrouding is to bleach the external fat, while it also accomplishes all of the benefits of a plain shroud. The only real disadvantage is with salt water shrouding a condition called "salt burn" or "salt run" develops on thinly finished beef carcasses. Placing a salt water shroud on a side of beef with thin fat covering will tend to discolor the red meat, turning it a dirty gray color, presenting an unattractive appearance.

j. Chilling - Chilling should be accomplished as rapidly as possible. However, care should be taken that the sides are not subjected to too cold a temperature. Extremely cold temperatures have a tendency to freeze the exterior surface and thus prevent adequate rapid chilling of the internal meat.

(1) Temperature - A cooler temperature of 32°F to 38°F is recommended. The product should be chilled to 40°F or under and should not be frozen. Care should be taken to prevent carcasses from touching, thus allowing for maximum air circulation. Cooler doors should also be kept closed to prevent temperature fluctuation.

(2) Humidity - The humidity is also important in maintaining the freshness of carcass meats. Humidity that is too low will result in excessive carcass shrinkage and poor cooling. On the other hand, humidity that is too high will cause the carcass to become slimy. Experience has shown that the best humidity for beef chill boxes is from 75 to 85 percent.

(3) Frozen Products - Frozen beef is first chilled in a chill box at 32°F to 38°F. In order to freeze the product it is placed in a blast freezer rapidly bringing the temperature to 0°F. The initial freezing of beef must be below 10°F. For U.S. Armed Forces procurement, the product must be held at 0°F or lower after the initial freeze. This temperature must be maintained up to, during shipment, and upon arrival of the product at destination. Finally, unless otherwise specified, frozen beef for U.S. Armed Forces procurement will not normally be held in a frozen state longer than 180 days.

k. Sales Cooler - Beef carcasses move from the chill box to a sales cooler for further processing. The shrouds have served their purpose at this point and are removed. Ribbing is accomplished by cutting between the 12th and 13th ribs to expose the longissimis dorsi muscle (eye of beef). USDA graders can now examine the carcass for conformation and quality and determine a quality grade. Carcasses are usually sold from this point to meat retailers who process them into retail cuts.

3. Quality Grading - The USDA has developed a system of classifying carcasses into a few definable quality groups according to the desirability of the product. The desirability or degree of excellence of each carcass is determined by evaluations of conformation and quality made by USDA meat graders. Each characteristic is evaluated separately but with a combination of the results a quality grade is awarded. The USDA quality grades in decreasing order are Prime, Choice, Good, Standard, Commercial, Utility, Cutter, and Canner.

a. Conformation - The shape in which the carcass or primal (wholesale) cut is formed is referred to as its conformation. In general, conformation can be described as the relationship of the width to the length of a cut or carcass beef. Beef having highly desirable conformation is often described as being thickly or fully muscled, round, or wide and thick in relation to length. The conformation descriptions for each of the grade specifications refer to the thickness of muscling and to an overall degree of thickness and fullness of the carcass and its various parts. Carcasses or primal cuts which meet the requirements for thickness of muscling specified for a grade are considered to have adequate conformation despite the fact that they may not have the overall degree of thickness and fullness desired because of a lack of fatness.

(1) Determination of Conformation - Evaluation of conformation should be performed by taking an average of the conformation of the various parts of the carcass or primal cuts. Each part must be considered with regards to its weight in proportion to the weight of the whole carcass and the general value of each part must be compared with the other parts. For example, the chuck and round are nearly the same percentage of the carcass weight, but the round is considered the more valuable cut. Therefore, in evaluating the overall conformation of a carcass, the round will be given more consideration than the development of the chuck. Similarly, the loin receives much more consideration for conformation than the rib, since it is a more valuable cut and comprises a greater percent of the carcass weight.

(2) Ideal Conformation - Superior conformation implies a high proportion of meat to bone and a high proportion of the weight of the carcass or cut in the more valuable parts. It is reflected in carcasses and cuts which are very thickly muscled, very full and thick in relation to their lengths and which have a very plump, full, and well-rounded appearance. Inferior conformation implies a low proportion of meat to

bone and a low proportion of the weight of the carcass or cut in the more valuable parts. It is reflected in carcasses and cuts which are very thinly muscled, very narrow and thin in relation to their length, and which have a very angular thin, sunken appearance.

b. Quality - Quality is the flavor, juiciness, tenderness, and overall acceptability of a carcass. The indicators of quality are maturity as indicated by the color and hardness of the bone, marbling which is intramuscular fat, color of the lean, and texture or firmness of lean. Evaluation of these characteristics will give the meat grader an estimate of the palatability a carcass may exhibit to a consumer. Carcasses awarded the USDA Prime grade exhibit these characteristics to the highest degree and are very high in palatability.

(1) Maturity - Highest quality carcasses are produced by youthful animals because of the proven tenderness in young carcass meats, for example, the less use a muscle is subjected to, the greater the tenderness. Also, as an animal matures, additional amounts of tough connective tissue are deposited between muscle walls. Carcass maturity can be estimated by examining bone character in carcasses. Youthful animals will exhibit soft, red, porous bones which are not ossified in areas such as the buttons, chines, ribs, and sternum. Mature animals have hard, white, non-porous bones indicating ossification. The importance of bone observation is emphasized by the fact that quality determinations cannot be accurately made in meat separated from the bone.

(2) Marbling - The fat distributed intramuscularly is known as marbling. In contributing to quality, marbling adds flavor, juiciness, and tenderness to meat cuts. Flavor and juiciness are acquired during the cooking process as fat breaks down. The tenderness is a result of fat being deposited next to the connective tissue of the muscle cell wall. As marbling is deposited, it forces the tough connective tissue to flatten and stretch, thereby weakening its structure. High quality carcasses exhibit liberal amounts of marbling along with youthfulness. Plentiful marbling cannot be used as an indication of quality without the maturity indication of bone because mature (hard-boned) cows also show liberal marbling.

(3) Color of Lean - References to color of lean in the grade descriptions involve only colors associated with changes in maturity. The normal variation in color is from light cherry red to purple (deep red) as the animal matures, but this is not always true. Since color of lean is also affected by variations in quality, references to color of lean in the grading descriptions for a given degree of maturity vary slightly with different levels of quality. In determining the maturity of a carcass or cut in which the skeletal evidences of maturity are different from those indicated by the color, slightly more emphasis should be placed on the characteristics of the bones and cartilages than on the characteristics of the lean. In no case, can the overall maturity

of the carcass or cut be considered more than one full maturity group different from that indicated by its bones and cartilages.

(4) Texture of Lean - The texture or firmness of the lean, much like the color, changes with advancing maturity. The small size of muscle fiber bundles in young carcasses and the lack of tough connective tissues lend the muscle to a smooth and springy texture. As the animal matures, muscle fibers become larger and connective tissue is deposited in noticeable amounts to increase toughness. Texture, along with color, are considered only in such case that other maturity factors appear slightly below the requirement for any grade. A carcass may show, for example, bone character below the requirement for USDA Good, but the texture and color may be high enough to bring the overall quality in line for this grade.

c. Compensation - The final grade of a carcass or primal (wholesale) cut is based on a composite evaluation of its conformation and quality. Since few carcasses have identical development of conformation and quality, superior amounts of one may compensate for deficient amounts of the other. A superior quality in all grades is permitted to compensate for a deficiency of conformation. The rate of compensation must be on an equal basis. For example, a given degree of superior quality, above the minimum required for the same degree of deficient conformation. In a similar way, superior conformation may compensate for deficient quality in all grades, except prime, choice, and commercial, at the rate of one-third. The conformation must be at least one-third more than the required minimum conformation required for the grade concerned.

d. Quality Grading Classes - Based on the characteristics of meat and bone, beef carcasses are divided into two classes for quality grading. The first division is steers, heifers, and cows which can grade all eight quality grades. The second division or class is made up of young bull carcasses which have not yet developed secondary sex characteristics. These young bulls are marked as "Bullock" and may be awarded Prime, Choice, Good, Standard, or Utility grades. Due to the difference in lean meat characteristics, the bullock is graded by a different set of standards than steers, heifers, and cows. Regardless of the sex or class designation, each carcass is graded on meat bone characteristics, and the similarity of steers, heifers, and cows allow them to be graded with the same standards. Although bull and stag carcasses were quality graded in the past, the economic return did not warrant continued quality grading, therefore their carcasses are only yield graded.

4. Cutability or Yield Grading - Beef carcasses can be considered to consist of lean, fat, and bone. The lean along with marbling and certain amounts of other acceptable and palatable fats furnish the edible portions. Large deposits of external and internal fat on a carcass are not desired and must be trimmed from the lean. Bone, although a functional necessity to the animal, is not edible and must be considered as waste. The edible and palatable portion of the carcass remaining after trimming and boning

can be described as a percent or ratio of the whole carcass. This ratio is referred to as the cutability or yield of the carcass.

a. Variable Factors - There are five cutability grades or groups designated 1 through 5. These grades are determined by four variable factors; the thickness of external fat; the amount of kidney, pelvic, and heart fat; the carcass weight; and the cross-sectional area of the rib eye muscle. The factors are used with five constants in a mathematical formula furnished by the USDA to compute a grade designation. The formula takes the following form: Cutability group = 2.50 + 2.50T + 0.20P + 0.0038W - 0.32A.

(1) Thickness of Fat = T - The amount of external fat on a carcass is evaluated in terms of the thickness of the fat over the rib eye muscle. The rib eye fat is measured perpendicular to the outside surface at a point three-fourths of the length of the rib eye from its chine bone. This measurement may be adjusted, as necessary, to reflect unusual amounts of fat on the other parts of the carcass. Each one-tenth inch change in adjusted fat thickness over the rib eye can change the cutability grading by 25 percent of a cutability group.

(2) Percentage of Fats = P - The amount of kidney, pelvic, and heart fat considered in determining the cutability group includes the kidney knob, the lumbar and pelvic fat in the loin and round, and the heart fat in the chuck and brisket area. These fats are removed in making closely trimmed retail cuts. The amount of these fats is evaluated objectively and expressed as a percent of the carcass weight a difference in the amount of these fats equal to 1 percent of the carcass weight will change the grade by 20 percent of a cutability group.

(3) Carcass Weight = W - Hot carcass weight is used in determining the cutability group. As the carcass weight increases, the percent of retail cuts decreases. A difference of 100 pounds of hot carcass weight will change the grade by approximately 40 percent of a cutability group.

(4) Area of Rib Eye = A - The cross-sectional area of the rib eye is determined where this muscle is exposed by ribbing. This area is usually estimated subjectively, although it may be measured. An increase in the area of rib eye proportionally increases the amount of retail cuts. A difference of 1 square inch in rib eye area may change the grade by approximately 30 percent of a cutability group.

b. Cutability of Wholesale Beef Cuts - Yield grades can be applied to wholesale market cuts by using the same formula. The forequarter, hindquarter, ribs, loin full-trimmed, and short loins trimmed are examined for the four variable factors and designated a yield grade from the USDA formula. Since hot carcass weight is used in the formula and these cuts are chilled, factors are available to convert the chilled weight of the cuts to a hot carcass weight. The percentages of fat in the kidney, pelvic, and heart regions are also available by quality grade

for the wholesale cuts.

(1) Hot Carcass Weight - Obtaining the hot carcass weight from chilled weights of the wholesale cuts is accomplished by multiplying the chilled weights by a constant. The constants are based upon the percentage of shrinkage each cut undergoes during chilling and the percentage each cut comprises in the carcass. The conversion constants for these cuts are:

Forequarter	3.90
Hindquarter	4.25
Rib	22.75
Loin, full-trimmed	12.75
Short loin, trimmed	29.10

(2) Percentage of Fats in Wholesale Cuts - Constants are also available for each quality grade to use in the formula for the variable of kidney, pelvic, and heart fat. These are established from much experience in grading carcasses and knowing, for example, the percentage of these fats in prime carcasses is most often 4.5 percent; therefore, a prime quality cut would be from a carcass with the same fat percentage. The constants according to quality grades are:

GRADES	PERCENTAGE of Kidney, Pelvic, and Heart Fat
Prime	4.5
Choice	3.5
Good	3.0
Standard	2.0
Commercial	4.0
Utility	2.0
Cutter and Canner	1.5

SECTION F - THE FEDERAL SPECIFICATION FOR CARCASS BEEF

1. Class - Beef classes refer to the sex of the animal. The three classes considered are steers, heifers, and cows with bull and stag carcasses excluded from procurement. Since class is a specification requirement and may be specified in a procurement contract, determining carcass sex is a necessity during inspection.

a. Class Description - The classes defined within the federal specification are members of Class 1 of the USDA quality grading sections. All of these animals can be awarded one of the eight quality grades except cows cannot grade prime. The characteristics of all three classes described are desirable for the military, which purchases the USDA grades of choice and good.

(1) Class 1 - The male beef animal castrated before reaching sexual maturity belongs to this class. Commonly called steers, these animals are castrated to prevent the development of secondary sex characteristics. The development of these characteristics yields a carcass with dark red color of lean, scarce yellow fat deposits, and large deposits of connective tissue causing the lean to be tough. Such characteristics are undesirable and are most evident in bull and stag carcasses.

(2) Class 2 - These animals are female bovines that have not reached sexual maturity called heifers. The lean and bone characteristics are much like a steer carcass. The evidence of youthfulness and the lack of secondary sex characteristics make heifers and steers most desirable.

(3) Class 3 - The mature female, called cow, is found within this class. These animals exhibit many of the quality characters seen in heifers and steers but are long on maturity as noted in bone character. The conformation is more angular than blocky but these animals are often desirable.

b. Sex Determining Factors - Sex must be determined by examination of the carcass during inspection. There are four factors which can be examined on each hindquarter to determine the sex or class of an animal.

(1) Pizzle Eye - If the carcass is split exactly in half, the pizzle eye will be visible just posterior to the aitch bone in male carcasses. It serves as the muscle attachment of the ligament of the penis. It is normally one-half inch in diameter but may be larger in bull carcasses.

(2) Pizzle Eye Cap - The lean muscle surrounding the pizzle eye is the pizzle eye cap. This muscle is found only in male carcasses and gives the posterior end of the aitch bone a different appearance in each sex. In the female there is fat at the posterior end of the aitch bone, since there is no pizzle eye cap or pizzle eye.

(3) Gracilis Muscle - Splitting the carcass exposes the gracilis muscle in the hindquarter, extending from the cod or mammary fat to the posterior end of the aitchbone. The female gracilis muscle is bean-shaped and free of any fat covering. Since this muscle is completely exposed with no fat covering in the female, the term "bald spot" is often used to describe it. Male gracilis muscles have a v-shaped fat covering over the posterior one-half and do not appear bean-shaped.

(4) Udder and Cod Fat - The cod fat is found in males and udder or dug fat is characteristic of females. Cod fat is the rough, knobby fat of the scrotal sac in steers. The dug fat is mammary tissue of cows and heifers. It is smooth in texture and more extensive in heifers than cows.

2. Style - Style refers to the method or manner of cutting the carcass. The term is described within the federal specification for five styles and each is considerably different. The different styles must be understood because the military uses such terminology on procurement contracts and other inspection documents.

a. Style I, Carcass Quartered - The beef carcasses in this style should consist of four matched quarters obtained by splitting the vertebrae along the median plane and ribbing the animal, which is to sever it between the 12th and 13th ribs. Each quarter must be marked with a number to identify it with a specific carcass. It should be understood that trimming is done according to the purchasing agreement or contract and may vary from the specification. Trimming may include removal of the diaphragm, but if not removed, the tendinous portion (serous membrane) must be removed to expose lean tissue. The thymus gland, mediastinal tissue, and heart fat shall be closely trimmed and removed. In addition, female carcasses must have the mammary tissue (udder) trimmed to no more than one inch in thickness. The hanging tender, a poorly bled muscle of the abdominal cavity, must also be trimmed to one-quarter of an inch. Other fats and trimming may be specified in such areas as the kidney knob, pelvic, lumbar, and thoracic regions, depending on the contract.

b. Style II, Side - Beef in this style consist of one matched forequarter and hindquarter from one-half of the carcass. The quarters are marked for identification as in carcass quartered. The trimming requirements are equal to Style I specifications.

c. Style III, Forequarter - The anterior one-half of the carcass separated by splitting and ribbing comprises this style. It will contain twelve ribs and should comprise 52 percent of the weight of one side. Trimming and processing are in accordance with carcass quartered.

d. Style IV, Hindquarter - The hindquarter should consist of the posterior portion of a side. Separation from the forequarter is between the 12th and 13th ribs leaving one rib in the hindquarter. It is approximately 48 percent of the total weight of one side. Trimming and processing requirements are equal to carcass quartered.

e. Style V, Wholesale and Fabricated Cuts - The cuts derived from beef carcasses through normal commercial practices are included within this style. All products must be processed under the USDA stamp of wholesomeness and the applicable quality grade. The raw materials must be chilled, sound, well dressed, split, and quartered beef carcasses. There are twenty-two basic wholesale market cuts including ground and diced beef which can be further processed to yield a total of seventy-two wholesale cuts derived from each carcass side. The enumeration and description of each cut is detailed in the federal specification, therefore only the basic cuts will be discussed.

(1) Style V, Round Primal - The round primal with the rump and shank on is that portion of the hindquarter remaining after the removal of the untrimmed full loin and flank. The untrimmed full loin and flank are severed from the hindquarter by cutting in a straight line perpendicular to the contour of the outside (skin side surface) of the hindquarter. The cut starts at the junction of the last (fifth) sacral vertebra and the first caudal vertebra. The cut continues through the flesh, just missing the end of the protuberance of the femur bone. It exposes the ball of the femur bone and continues in a straight line to completion. The tip or rear innermost corner of the fifth sacral vertebra remains attached to the first tail bone. Finally, all cod udder, and pelvic fat on the round, after separation, may remain.

(2) Style V, Loin, Full-Trimmed - The loin is that portion of the hindquarter remaining after severance of the round, flank, hanging tender (present on left side only, which is referred to as the open side), kidney knob, and excess fat from the lumbar and pelvic (sacral) regions inside the loin. The short loin and sirloin (loin end) are in one piece. The backbone of this portion includes 1 1/2 thoracic vertebrae, 6 lumbar vertebrae, 4 sacral vertebrae, and the tip of the innermost corner of the fifth sacral vertebra. The kidney knob, including the kidney and the fat lying closely around the kidney, is removed from the loin by a cut starting at the rear end of the kidney and slanting at the rear of the 13th rib. This leaves the 12th rib practically free of lumbar fat. The hanging tender is entirely removed at a point opposite the juncture of the first and second lumbar vertebrae. The flank is severed from the loin at the ventral point of the round, with no more than 1 inch of fat remaining on the flank side of the face of the loin, and continuing in a straight line to a point on the inside of the 13th rib. This point is determined by measuring 9 to 10 inches, in a straight line, from the center of the protruding most ventral edge of the 13th thoracic vertebra. The fat is trimmed from the internal lumbar section of the loin with the full loin lying unsupported and with the meat side (outer surface or skin side) down on a flat surface.

(3) Style V, Flank - The portion of the hindquarter remaining after severance of the full loin is the flank. Its separation from the hindquarter was discussed in Style V, loin, full-trimmed.

(4) Style V, Short Loin - A perpendicular cut to the contour of the outside (skin side) surface of the loin, full-trimmed yields the short loin. The cut is made at the junction of the fifth and sixth lumbar vertebrae, and continues in a straight line to the end of the hip bone. Not more than 1 inch of the pin bone and related cartilage is to be left on the short loin.

(5) Style V, Sirloin (loin end) - This is the thicker, posterior portion of the trimmed full loin remaining after severance of the short loin.

(6) Style V, Cross-Cut Chuck - This cut is obtained from the forequarter by cutting through the 5th and 6th ribs in a straight line. The cut is continued through the costal cartilage, breast bone (sternum), and related meat until severance is complete.

(7) Style V, Square-Cut Chuck - The square-cut chuck, which is also referred to as the regular chuck, is obtained by removing the foreshank and brisket from the cross-cut chuck. A cut is made through the cross-cut chuck in a straight line perpendicular to the contour of the outside (skin side) surface. This cut separates the combined brisket and foreshank from the cross-cut chuck, leaving the square-cut chuck.

(8) Style V, Foreshank - Foreshanks are obtained from the forequarter after removal of the cross-cut chuck and the brisket. The natural seam of the flesh is followed, leaving the "lip" or web muscle on the brisket.

(9) Style V, Brisket - The brisket is removed from the cross-cut chuck by cutting in a straight line perpendicular to the long axis of the ribs, from the anterior extremity of the sternum cartilage. This cut extends to, and includes, the fifth rib so as to form a right muscle.

(10) Style V, Rib Primal - It is that portion of the forequarter remaining after removal of the cross cut chuck, and short plate. It contains parts of seven ribs, the sixth to the twelfth inclusive. The cut starts not more than ten inches from the center of the protruding edge of the 12th vertebra and continues in a straight line, terminating at a point between the fifth and sixth ribs, measuring not more than ten inches from the inside of the sixth vetebra. The portion of the diaphragm remaining on the full rib after cutting is removed.

(11) Style V, Short Plate - The portion remaining in the forequarter after removal of the cross-cut chuck and rib primal is the short plate. The short plate contains parts of seven ribs (6th to 12th), the costal cartilages, and the part of the sternum bone that extends posteriorly to the fifth rib. The cut necessary to achieve the short plate was discussed in Style V, rib primal.

(12) Style V, Back - The back contains the full rib and square-cut chuck of the forequarter all in one piece. This means that the short plate, foreshank, and brisket have been removed. Separation is accomplished in a smooth, continuous cut.

(13) Style V, Triangle - The triangle consists of the forequarter, minus the rib primal. It contains the short plate, brisket, foreshank, and square-cut chuck, all in one piece.

(14) Style V, Armbone Chuck - The armbone chuck is derived from a cross-cut chuck by removing the brisket as though a square-cut chuck would be produced but the foreshank remains.

3. General Inspection Requirements - Inspection is accomplished by the procuring agency of the Federal Government, or by a duly authorized representative, at a time and place designated by the procuring agency. It may be at the site of preparation (both during and after preparation), at a suitable point in transit, or after delivery at destination. Unless otherwise specified, final inspection is normally accomplished at the time of delivery to destination. Regardless, the supplier or contractor is responsible for meeting all the provisions of the Federal specification under which the product was manufactured, prior to offering the product to the U.S. Government for acceptance. The contractor is further required, unless otherwise specified in the contract, to furnish an official inspection certificate issued by the USDA certifying that the grade of the product supplied is as required by the contract. Contractor's inspection records of the examination of the product should be complete and available to the U.S. Government upon request. The U.S. Government reserves the right to perform any of the inspections set forth in the Federal specification under which the product was purchased, where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

a. Contract Compliance - When inspecting for contract compliance, you should have a copy of the contract in hand. Be thoroughly familiar with the document and all related publications, such as clauses and specifications, cited in the contract. An inspection of the product should include an examination of its grade, weight, temperature, and markings. Also, the cleanliness and the temperature of the vehicle used to transport the product should be checked, as well as that of the beef holding or storage rooms. When inspecting the product for wholesomeness and soundness, check for the presence of objectionable odors, bruises, blood clots, multilations, and discoloration. Beef should also be free of other detrimental blemishes, ragged edges, superficial appendages, and deep cuts. There should be no evidence of refreezing, freezer burn, mishandling, and other deterioration or damage. In other words, the beef is to be in excellent condition. It should possess the quality and other characteristics associated with the style, grade, class, and condition specified in the purchasing instruments and all the referenced documents upon delivery at destination. Beef that is substandard for any reason, based on the requirements discussed so far, should be rejected.

b. Condition Defects and Deterioration - The purpose of inspection at destination is to verify the product as being sound or in excellent condition and in compliance with the contract. An understanding of major carcass defects and areas of deterioration is necessary to insuring a product that is wholesome for issue and of quality equal to the price paid by the government.

(1) Defects of Carcass Beef - The abnormalities seen in carcass beef can be internal or external defects which are present at slaughter or occur as latent defects. The major quality defects and causes of unwholesomeness are easily detected during verification inspections.

(a) The Eye of Beef - The longissimus dorsi muscle, which is commonly referred to as the eye of beef in carcass beef, is exposed in both hindquarters and forequarters. As the carcass is ribbed to develop quartered beef, the eye of beef is exposed in the hindquarter as loin eye and in the forequarter as ribeye. This exposed muscle can indicate various abnormal conditions which affect the entire carcass.

1 Dark Cutter Beef - The dark color and sticky, gummy texture of this meat is esthetically not acceptable. These animals are depleted of glycogen (energy sugar) from which lactic acid is produced in the muscle. Lactic acid is a normal constituent of the muscle and maintains the pH low and acid. With glycogen depleted, lactic acid is not produced and the pH is high and alkaline. Muscle enzymes and bacteria become very active in this increased pH and deplete the oxygen available for combining with the muscle protein, myoglobin. The red color of meat is created by muscle protein absorbing oxygen and as a result of glycogen depletion; yielding no lactic acid, an increase in activity, and lack of available oxygen, muscles become dark or black in color. The sticky, gummy texture is a result of the alkaline pH breaking down the muscle protein. Such carcasses are normally graded down one full quality grade in the top five grades only, as it is not considered as a factor in the lower grades.

2 Spotters - The most probable cause is excitement prior to slaughter, which results in improper bleeding. Dark hemorrhage spots of varying size are evident throughout the muscle tissue of the eye of beef. It is most often seen in top grade cattle that are not accustomed to exercise. The presence of these small hemorrhages encourages deterioration and contamination in carcass beef. The disposition of such carcasses depends upon the severity and location. Severe cases are rejectable in the processing establishment for military products, while the USDA may only down grade the carcass for esthetic reasons.

3 Two-Toning - These carcasses exhibit two definite shades of red coloring in the eye of beef. The cause for this color difference is unknown and disposition is most often to accept. There is no wholesome factor in danger and only esthetic values are considered.

4 Sore of Scar - This is a small off-white water spot in the longissimus dorsi muscle which is soft and has the appearance of a very unappetizing sore. The larvae or grub of a fly, Hypoderma lineata, penetrate the eye of beef and the hide leaving a sore. Such carcasses are rejectable in the processing establishment and must be trimmed at destination.

5 Callous - Deposits of heavy connective tissue resulting from a healed injury are referred to as callouses. A puncture type wound or injury to the beef eye will be healed by tough connective tissue. Rejection on the basis of poor quality is rare, but possible.

(b) Latent Defects - The potential danger of these defects from a wholesomeness viewpoint make them important. Each one is dangerous to varying degrees and severity is the measurement for disposition. Time in storage is very important in most cases because these defects are often not dangerous until some deterioration occurs.

1 Sour Round - Sour round can be detected in the ball-and-socket joint of the hindquarter with a meat trier. The meat trier is smelled after inserting and removing it from the ball-and-socket joint. The organism, Bacillus megatherium, is present in this joint and becomes very active after slaughter. Due to poor chilling of heavier rounds, poor ventilation, or slow cooling, the organism becomes active and releases propionic gas as a waste product. The gas is non-toxic but does produce a noxious odor. Carcasses possessing sour rounds should be rejected and returned to the contractor. If detected after final acceptance, the procurement agency concerned should be notified so that possible recover action involving latent defects may be taken. If the beef is Government-owned, the rounds should be split to the bone so that you can examine the surrounding tissue for a grayish discoloration. The grayish discoloration, if present, should be trimmed away and discarded, and the remainder of the hindquarter should be allowed to air out in a chill room. If no discoloration is present, airing the product in a chill room overnight will probably destroy the off odor and off flavor associated with sour rounds.

2 Abscesses - The encapsulation of disease tissue by certain white blood cells is an abscess. There is a collection of pus-like material present which is a result of the white blood cell activity. The normal location is on internal surfaces but there may be some externally. The presence of abscesses indicates bacterial invasion or contamination, and are dangerous when found in association with lymph glands because it indicates a systemic disease. The USDA will condemn entire carcasses for abscesses and the military can reject abscessed carcasses during acceptance inspections. If the product is Government-owned, smaller abscesses are trimmable, but larger ones may warrant throwing out the product.

3 Bruises - Bruises are blood collections associated with damaged tissue. Most bruises are superficial in nature but some are penetrating. Since these areas are breeding grounds for bacterial spoilage, trimming is required. The disposition is normally to accept and trim, but judgment must be used in severely bruised carcasses.

4 Mold - Beef carcasses exhibiting mold are indicative of an old improperly stored product. The mold is not toxic but must be washed from the carcass. Vinegar and water are used to wash the carcass and storage area.

5 Cuts and Mutilations - Carcasses exhibiting cuts and mutilations are produced from poor workmanship. These carcasses are subject to rejection due to poor quality. One consideration would be the affect of gross cuts on the processing of a carcass into retail cuts, because some cuts could prevent proper processing.

(2) Deterioration - The natural breakdown of carcass meats begins with slaughter and will terminate with complete rancidity and decomposition or by consumption. The most important factors involved in controlled deterioration are temperature, humidity, and circulation during storage. If old products are delivered, rejection is in order but acceptance with immediate issue may suffice. The important point here is, on acceptance inspections, the product should not show more than normal signs of deterioration if it is in excellent condition and this is a specification requirement. The areas discussed here will give sufficient indication of deterioration and can be used at origin, destination, or in storage.

(a) Hanging Tender - The hanging tender is located on the left hindquarter in a dressed carcass. It is exposed muscle tissue which does not drain well during bleeding and due to its being exposed, it dehydrates rapidly. With blood and serum drippings from other parts of the carcass, it may serve as a breeding ground for bacteria. Specification requirements are to trim this muscle to one-quarter of an inch, but the contract may vary.

(b) Jugular Furrow - The jugular furrow, which is the pathway of the large blood vessels in the neck, is another area. The vein which is stuck in bleeding of the animal during slaughter is located in the jugular furrow. Blood seepage and se[illegible] in this area promotes the growth of spoilage-causing bacteria. The presence of off odor is a good indicator.

(c) Diaphragm - The portion of the diaphragm remaining after dressing a carcass is called the skirt. There is poor air circulation under this skirt muscle and slime is often found here. The presence of this slime will lead to bacterial contamination and off odors.

(d) Flank - The flank folds inward as a carcass is suspended by the gambrel tendon. This fold in the flank gives the posterior abdominal region poor air circulation and slime soon develops. The situation here progresses as the slime under the skirt.

(e) Muscle Surfaces - Cross-grain cut surface muscles tend to dehydrate and deteriorate more rapidly than surfaces covered with fat. Sliming and bacterial decomposition occur in these areas earlier than in other parts of the carcass. The gracilis muscle, the eye of beef, the hanging tender, and the brisket are all exposed in quartered carcasses and can be examined for soundness or condition.

c. Net Weight - Carcass beef is not weighted by one of two methods according to the Subsistence Inspection Manual. Weighing may be accomplished at origin and destination or as deemed necessary by the Accountable Receiving Officer. The scales shall be periodically checked for accuracy and this requirement will vary from origin to destination. If beef is weighed one-hundred percent, any shortage will be significant and reportable to Subsistence Regional Headquarters if the value of the

shortage is $10.00 or more. Using Q-Allowances, the sample size must be at least thirteen and significant shortages are determined by comparing the average shortage to the Q-Allowance. Reporting shortages with the latter method is also based on those shortages of $10.00 and over.

SECTION G - BEEF ROASTS AND STEAKS, BONELESS, FROZEN

1. Fabricated Beef - Fabricated beef was first introduced into the military subsistence during World War I and was known as "no bone" beef. At this time the product consisted of 100 pounds boxes of various boneless meat cuts, making utilization very difficult. Today, after many years of trial and error study, fabricated beef has become such an outstanding product that it has virtually replaced carcass beef in dining halls. The specification refers to it as Beef Roasts and Steaks, Boneless, Frozen, but it is more commonly known as "fabricated" beef.

a. Advantages - Fabricated beef possesses many advantages which have made the product successful. The removal of all bone and waste, for example, have made the product 30% less in shipping weight, taking 60% less shipping space. The number of personnel and the amount of equipment necessary for handling and preparing have also decreased. Packing and packaging the product in polyethylene bags and wax-lined boxes is a deterrent to contamination and spoilage, thereby, lengthening the storage time. Troop issue is also made easier, since the product is uniform and ready to prepare and issue without trimming or boning.

b. Disadvantages - In fabricated beef procurement and use, some disadvantages have been discovered, but the overall product is excellent for troop issue subsistence. Since the product requires additional processing, the initial cost of production and procurement are high. The loss of flavor and juiciness due to freezing and thawing are also disadvantages. The time required to properly thaw the frozen product has also been a disadvantage to food service personnel. Such things as freezer burn and subsequent dehydration can be evident if poor storage is practiced or boxes become torn.

2. Specification Classification - The specification for Beef Roasts and Steaks, Boneless, Frozen, MIL-B-43813, describes the product by terms such as Type and Style. The carcass is divided into roasts and steaks and the specification separates two Types of roasts and four Types of steaks. Since different fabricated cuts may comprise each Type, the term Style is used to differentiate.

a. Oven Roasts - The oven roasts are called Type I in the specification. The four cuts within this Type are located in the hindquarter. These cuts are high in moisture, low in connective tissue, and may be cooked in dry heat rather than moist heat. The tenderness and quality of these cuts are better than that of pot roasts; therefore, oven roasts are the higher valued cuts.

(1) Style 1 - Knuckle - The knuckle is ventral to the femur (round bone). The kneecap (patella) is loosened from the stifle joint and surrounding periosteum must be removed and excluded. A straight cut is made between the knuckle and the inside round beginning at the patella, to the round bone for the length of the bone. Another cut is made from the patella along the natural seam between the knuckle and outside round scoring it for its full length.

(2) Style 2 - Inside (top) Round - This muscle is removed by a straight cut from the muscular end of the gambrel cord and continuing through the natural seam along the eye muscle. A second cut is then made from the lower end of the gambrel cord to the top of the femur. The roast is then removed at the natural seam from the eye muscle. The thick opaque gracilis membrane just posterior to the aitch bone must be removed.

(3) Style 3 - Eye of Round - The eye of round consists of only one muscle and divides the inside and outside rounds. Located dorsal and distal to the femur, it is removed from the round through the natural seam between it and the two rounds.

(4) Style 4 - Outside (bottom) Round - With the heel, shank meat, and rump attached, the outside round is removed by cutting through the upper edge of the eye muscle to the shank bone, following the shank and round bones to separate the outside and the shank meat from the bones. It is located posterior to the femur and remains after removal of the knuckle. The heavy connective tissue between the round and knuckle and the popliteal lymph gland must be removed.

b. Pot Roasts - The three fabricated cuts considered as pot roasts are referred to as Type II. All are located within the forequarter and are characteristically tough muscles. There is much connective tissue associated with the already tough muscle and moist heat cooking is required to obtain tenderness.

(1) Style 1 - Chuck Roll (blade end) - The blade end is in referrence to the scapula or blade bone. The cut is separated at the 5th rib and between the first and second ribs. It is located adjacent to the chuck roll (neck end), which is anterior of the first and second ribs, and below the scapula or blade bone.

(2) Style 2 - Shoulder Clod - The large outside muscle of the clod is located directly on the scapula and ventral to the spine of the scapula. It should include the length of the forequarter, cut at the angle of the spine of the scapula, to the first natural seam distal of the spine. All of this is removed as one piece and split into equal halves for use as roasts.

(3) Style 3 - Chuck Roll (neck end) - The neck end chuck is bordered dorsally by the backline and lies anterior to the blade and chuck. The anterior edge is trimmed at the termination of the major muscle,

serratus ventralis, and the dorsal edge is trimmed by a straight cut 2 inches below the upper dorsal border formed by removal of the neck vertebrae.

c. Grill Steaks - The steaks within Type III are derived from the more expensive fabricated cuts. The longissimus dorsi muscle is the major component of the rib eye and loin strip steaks, while the much larger top sirloin butt, consisting of three major muscles, makes the remainder of this Type. The rib eye is derived from the forequarter, and the loin strip and top sirloin butt are in the hindquarter. These steaks are produced as formed products, giving them higher quality and greater uniformity.

(1) Style 1 - Rib Eye - The muscle group from which this steak is derived lies dorsal to the transverse process of the vertebrae and adjacent to the dorsal process (feather bones). It consists of the muscle between the 6th and 12th ribs with the rib cover and rib wing being removed through a natural seam.

(2) Style 2 - Top Sirloin Butt - The top sirloin is separated from the bottom sirloin through a natural seam. The cut consists of three large muscle groups beginning just posterior to the loin strip and continuing to the knuckle and bottom round. Prior to steaking, this cut must be split in half, lengthwise, parallel to the muscle grain.

(3) Style 3 - Loin Strip - The longissimus dorsi is the major constituent of this steak and lies dorsal to the transverse process of the vertebrae and adjacent to the dorsal process. The strip is removed through a natural seam from the vertebrae and the loin wing. It begins with the last thoracic vertebra and stops at the sacral vertebrae. The slightly attached muscle located dorsally, the multifidus dorsi, must be removed through the seam.

d. Tenderloin Steaks - The tenderloin muscle located ventral to the lumbar vertebrae is Type IV in the specification. The muscle is very tender and likewise expensive. There are no Styles for the tenderloin and at present their use is limited. It may be seen as a full tenderloin, which includes all of the psoas major and psoas minor muscles from the hip bone to the last thoracic vertebra. The muscle degenerates as it moves forward and is often too small on the anterior end to cut steaks. The other, more popular, form is the butt tenderloin which is the posterior one-half of the cut.

e. Swiss Steaks - The swiss steak of Type V in the fabricated beef specification is derived from the four Styles of Type I (oven roasts). Since three of the cuts are large (inside and outside rounds and knuckles), cutting into smaller pieces is required before steaking. The cuts are divided parallel to the muscle grain to allow steaks to be removed at right angles. These are medium quality steaks not requiring tenderization and weighing only six ounces.

f. Minute Steaks - The inside and outside round, eye of round, and the knuckle are also used to produce this Type VI product. The whole cuts are tenderized prior to steaking into three and four ounce steaks. These steaks are small and of medium quality and are often used for breakfast steaks.

3. Raw Materials - Fabricated beef will be prepared in establishments which are under the inspection of the Animal and Plant Health Inspection Service of the USDA. All constituents of the fabricated product must be derived from excellent condition beef carcasses. Carcasses are stored at 32°F to 40°F for no more than ten days postmortem with small areas of discoloration permitted. Steers and heifers are acceptable but bull and stag meat is excluded. The USDA quality grade of Good or better, the cutability grade of 3 or better, and the wholesomeness stamp are required. Weight and packaging dates are also within the specification and normally appear on purchasing documents.

4. Processing Requirements - All aspects of processing are specified and subject to inspection. The fabrication of carcasses is done in a standard manner by common commercial practices. The separation of fat from lean, bone from lean, tough from tender, and valuable from less valuable are the basic requirements. During processing, sanitation, temperatures, and identity of cuts are just some of the areas to be monitored.

a. Processing Times and Temperatures - The times are specified for steaks, from the start of processing to packing, the establishment has 15 days. During this time, the temperature must be 28°F to 40°F before boning and 42°F after boning and prior to freezing. Steaks are allowed a maximum of four hours from packing to freezing. The temperature of freezing at initial freeze is -10°F and for storage 0°F. Two methods are used to freeze fabricated beef; conventional blast freezers reaching 0°F within 72 hours, and individual quick freezers reaching 0°F in one hour.

b. Special Requirements - All Styles must have not more than 1/2 inch of surface or seam fat and no periosteum of one square inch or more. Lymph glands must be removed throughout the carcass, such as, the popliteal gland in the bottom round and the prescapula in the chuck roll (blade end). Five cuts are split in half as special requirements; the knuckle will be split if over ten pounds, the top sirloin butt is split before steaking, and the top round, bottom round, and clod are always halved for roasts. Tenderization is specified for some Styles and Types, but only for whole cuts.

(1) Tenderization - A series of large needles are used to puncture the tougher cuts and break down the cell walls, thereby, making the muscle more tender. The bottom round in Type I, Style 4, is tenderized for an oven roast, but not for swiss steaks in Type V. Type III, Style 2, top sirloin butts are also tenderized before steaking for grill steaks. The only Type where all Styles are tenderized is Type VI, minute steaks, and these are done as whole cuts also.

(2) Formed Steaks - All formed steaks follow the same process beginning with freezing at 0°F. The items are frozen as whole cuts then vacuum bagged. Prior to forming the steaks under 350 PSI, tempering must occur. Tempering is done by bringing the product up to 24°F to 28°F before pressing. Immediately after pressing, the product is sliced automatically to the proper size and weight then refrozen.

c. Definition of Terms - The specification for fabricated beef requires examination of the end item for product characteristics. The different characteristics are referred to by using terms which must be understood prior to examining the product. All terms used are common rather than scientific and are defined within the specification. Each term is described and the requirement for individual Styles is given.

(1) Surface Fat - The fat found on external surfaces of the carcass or individual cuts is called surface fat. Reasonable amounts of surface fat are required for higher quality carcasses, but during boning and trimming, excess or waste fat is removed. The specification permits one-half inch of surface fat in all Styles of fabricated beef with bridging of fat pockets allowed. Bridging involves placing a ruler across fat pockets extending into the lean, and measuring from the ruler to the outside surface. This measurement may not exceed one-half inch, and the width of the fat pocket cannot exceed one inch.

(2) Seam Fat - The seam fat in carcass beef is found surrounding lymph glands and inside natural seams of muscles. The term intermuscular fat is often used to describe seam fat, because it lies between muscles. The normal fabrication of carcasses will cause seam fat to appear as surface fat on many cuts, therefore, the trimming requirement is also one-half inch for seam fat.

(3) Semi-attached Fat (Tag End) - These pieces of fat, muscle, connective tissue, or a combination of such are examples of poor workmanship. The allowance is for such tissue not to exceed one inch in length and to support the weight of the cut if raised by the distal one-third of the tag end. The occurrence of tag ends has been decreased by requiring additional trimming of certain small muscles, such as the multifidus dorsi on loin strips. This prevents the slightly attached muscle from separating during processing and becoming a tag end.

(4) Bruise - Bruises indicate damaged muscle tissue, due to rough handling of animals prior to slaughter or any severe blow to the animal. The connective tissue becomes opaque and the muscle is darkened by loss of circulation in an area. The specification limits bruises to no more than one inch in any dimension.

(5) Blood Clots and Spotters - The blood clot is an opaque mass of coagulated blood. It may appear in surface fat or muscle tissue as a result of a clotting reaction during slaughter. The dimensions should not be more than one-half inch in any direction. The spotter

tissue often seen in carcass beef is a ruptured blood vessel, normally a capillary which bursts during slaughter. It appears as hemorrhages rather than clots of coagulated blood in fabricated cuts.

(6) Bone and Cartilage - The gristle or elastic connective tissue of cartilage is unossified or not hardened as bone tissue. Bone or cartilage may be evident on cuts removed from joints, directly off bone surfaces, or any area of attachment for muscle to bone. The length of either may not exceed one-quarter of an inch.

(7) Cuts and Fractures - The fracture is any crack penetrating more than one-half the thickness of a frozen steak. These result from rough handling of frozen products while cuts or scores occur during boning and trimming. Poor workmanship in fabrication can result in large cuts on roasts or steaks. The allowance is one inch in depth and no more than two inches in length or width.

5. Finished Product - The end item should be free of any foreign materials or foreign odors. The condition should remain excellent as in the raw materials, showing no discoloration, sourness, rancidity, freezer burn, or dehydration. Defects defined in the specification, such as bone, cartilage, bruises, blood clots, excess fat, or deep cuts must be removed and excluded from the end item. Requirements are characteristic to roasts and steaks, separately, and must be closely examined.

a. Beef Roasts - There are two Types of roasts in fabricated beef, and these Types are completed with seven Styles. In both of the Types, the roast should consist of one individual cut as described in the specification, except that muscles of adjacent cuts may remain attached if not more than one-half inch in thickness. Trimming, boning, tenderizing, and splitting are accomplished in accordance with the specification, as some cuts require additional processing.

b. Beef Steaks - The steaks produced for fabricated beef are composed of seven Styles and divided into three Types. All steaks are separated at right angles to muscle grain of their respective Styles. The tenderization of all minute steaks and the top sirloin butt must be accomplished on whole cuts. Splitting of larger Styles parallel to the long grain is required to obtain the correct weight for end items. The length and thickness of each Type are specified within the specification and are required to provide a uniform product. Underweight steaks may be diverted to a steak Type with lower quality Styles, such as, grill steaks may be diverted to swiss steaks and the latter can become minute steaks. The evidence of thawing, refreezing, freezer burn, or dehydration will be cause for rejection.

6. Inspection Responsibility - The contractor is responsible for performing all inspections required within the specification. The acceptability

of a lot is first determined by the contractor's Quality Assurance Representative and these results are given to Government inspectors. In addition to the contractor's inspection, the Government reserves the right to perform any of the inspections set forth within the specification. Verification and acceptance of fabricated beef are required at origin but subsequent inspections are performed.

a. Class 3 - The origin inspection is the most inclusive and important of all the classes of inspection. Prior to processing, the raw materials are inspected for USDA grade, the stamp of wholesomeness, and acceptable grade. Each carcass or cut must also meet specified weight ranges, classes and the condition must be excellent as defined in the specification. As processing begins, the boning, trimming, splitting, and tenderization requirements must be closely observed to insure a quality end item. Many examinations are outlined within the specification and a complete origin inspection may include part or all of these examinations.

b. Class 4 - The destination examinations should include determining yield percentages for each Type of fabricated beef. Test weighing must be accomplished on both boxes and individual items according to the examination tables. The product must be at 0°F at receipt and evidence of thawing and refreezing may be cause of rejection.

c. Class 5 - The majority of inspection done on fabricated beef is on Government-owned products shipped from a depot to base level. The temperature and condition of these products are examined once again. It is important that thawing does not occur and the quality is maintained. An inspection for the identity is required for insuring that if, for example, Type III, Style 3, grill steaks are requested, that Type III, Style 1 is not shipped instead. The carrier is always responsible for any losses during transit, so at Class 5, the carrier is held responsible.

7. Ground Beef - Ground beef is produced in accordance with MIL-B-3854. The production of ground beef from cuts and trimmings generated during the processing of fabricated beef is common practice. The raw materials would meet the requirements of fabricated beef. There are two Types of ground beef; Type I = Bulk and Type II = Patties. The temperature prior to grinding is 42°F, as with fabricated beef, and during grinding the temperature may not exceed 50°F. The requirement for fat content is determined by the thermal extraction method and may not exceed 22% on any sample. Additional requirements and examinations are included within the specification and purchasing agreement and the listing of these would not be conclusive, because each contract differs.

SECTION H - INSPECTION OF VEAL AND CALF

1. Definition - The USDA defines veal as immature bovines which have subsisted on foods other than milk. Since the ages of these animals are difficult to determine, no specific age limit is established as the dividing line. The armed forces do not separate the two categories as

veal and calf for procurement purposes; however, inspection requires knowledge of the typical characteristics of each.

a. Veal and Calf Carcasses - Differentiation is made primarily on the basis of color of the lean, although factors such as texture of the lean, the character of the fat, and the size and the color of the rib bones are also considered. Typical veal carcasses have a grayish-pink color of lean that is very smooth and velvety in texture. Veal also has a slightly soft, pliable character of fat, and narrow, very red rib bones. By contrast, typical calf carcasses have a distinctly reddish color of lean, a harder, flakier type of fat, and somewhat wider rib bones, with less pronounced evidences of red color indicating an older animal.

(1) Veal - A veal carcass is a carcass derived from the slaughter and dressing of an immature, milk-fed, bovine animal, which is usually not more than 3 months of age. These carcasses weigh less than 100 pounds.

(2) Calf - A calf carcass is a carcass derived from the slaughter and dressing of an immature bovine animal which has subsisted in part or entirely on feeds other than milk for some time. These animals are usually 3 to 10 months of age producing carcasses weighing more than 150 pounds.

2. Specification Classification - During DPSC inspection, both veal and calf carcasses are referred to as veal; however, calf carcasses are mot often offered for DPSC contracts. During classification, the specification differentiates these animals by weight ranges only.

a. Classes - Class determination is based on the apparent sex condition of the animal at the time of slaughter. The classes are identical to those of beef; steers, heifers, cows, and bulls. The slaughter of bulls in this age group does not affect the carcass quality. Class determination as far as DPSC is concerned is not a point to be considered.

b. Item - Item refers to the method or manner of cutting the carcass. There are many items listed in the specification for veal and calf. Due to the comparative small size of the carcasses, there is not a need to divide the carcass for handling.

(1) Item 300 - Item 300 is the whole carcass, unsplit with no more than two tail vertebrae and with the hide and caul fat removed. Mediastinal tissue and heart fat in the lower thoracic region and the bloody tissue and frayed ends in the neck region must be closely trimmed. The skirt and hanging tender may be removed in whole or in part.

(2) Item 303 - Item 303 consists of the half portion of the carcass in Item 300. It is produced by splitting the carcass neatly and uniformly

through its spine, thus forming two sides. DPSC buys most veal and calf prepared in this manner.

(3) Item 302 - Item 302 consists of the wholesale market cuts formed by cutting the carcasses of Items 300 and/or 303. The cuts are removed by standard commercial practices, but the numbers of any specific cut will be less due to the size of these carcasses.

(a) Hindsaddle - The hindsaddle is the unsplit posterior portion of the unsplit carcass remaining after the 12-rib foresaddle has been severed, by ribbing the carcass, that is, separating the hindsaddle from the foresaddle by cutting between the 12th and 13th ribs, the 13th rib remaining on the hindsaddle and continuing the cut through the flank and plate portions at approximately right angles to the spine.

(b) Foresaddle - The foresaddle is the unsplit anterior portion of the unsplit carcass remaining after severance from the 13th rib hindsaddle as described above, and including the 1st through the 12th ribs.

(c) Hindquarter - The hindquarter is formed by splitting the hindsaddle lengthwise through the median section of the spine, thus separating it into two hindquarters.

(d) Forequarter - The forequarter is formed by splitting the foresaddle lengthwise through the median section of the spine, thus separating it into two forequarters.

(e) Leg - Unless otherwise specified, the leg is both legs remaining all in one piece as a pair after they have been separated from the double loin portion by cutting reasonably straight across and through the unsplit hindsaddle at right angles to the spine at a point just forward and adjacent to the hipbone.

(f) Loin - Unless otherwise specified, the loin will be both loins remaining all in one piece as a pair after they have been separated from the leg portion of the hindsaddle at the juncture of the hipbone as specified in the leg.

(g) Hotel Racks - Unless otherwise specified, hotel racks are both hotel racks remaining all in one piece as a pair after they have been separated from the double portion by cutting reasonably straight across and through the unsplit foresaddle at right angles to the spine and following the natural curvature between the 5th and 6th ribs, so that the 6th through the 12th rib will remain the double rack. The breast (plate) should be removed about 6 inches from and parallel to the most ventral point of the main body of the rib eye.

(h) Regular Chuck - Unless otherwise specified, the regular chuck is both regular chucks all in one piece as a pair, comprised of the

unsplit portion of the foresaddle remaining after the hotel rack has been removed from the foresaddle as specified in (g) above, so that it contains five ribs and the brisket. Practically all mediastinal tissue and heart fat are removed and excluded.

(i) Square Chuck - Unless otherwise specified, the square chuck is both square chucks produced from regular chucks specified in (h) above, except that the foreshank is removed between the elbow and the shoulder joint, exposing only the small round armbone, and the brisket is removed along the same line by cutting through at right angles with the ribs.

c. Weight Ranges - Weight ranges for veal and calf are divided as follows: range 1, or light weight; range 2, or medium weight; and range 3, or heavy weight. The ranges are given for each style and within each style there are separate weight ranges for veal and for calf. The weight range is from 60 to 275 pounds. When buying weight-range 3 or all weight ranges, the weight may be increased up to 150 pounds per side, making the upper limit for carcass (style 1) 300 pounds on the unsplit carcass. The weight range for veal carcasses used to produce frozen, semi-boneless veal is up to 325 pounds.

d. Condition Defects - Veal and calf carcasses are more perishable than either beef or lamb because of their comparative immaturity, high moisture content, and lack of fat covering. Bruises are commonly found on veal and calf carcasses because of the immaturity of the animals. Severe treatment such as whiplashing, overcrowding, and trampling by larger animals penetrates the tender flesh and causes bruises. The thin covering also reduces the amount of protection from rough treatment. Bruises may be found on the back, rump, or hip.

(1) Bruises - Bruises must not penetrate into the underlying muscle tissue. The presence of bruises is not a grading factor. The carcass is either passed or rejected. If it is rejected, it is for unsound condition and not for grade. Each carcass is examined carefully for bruises. If any bruises are noticed, it is advisable to have a plant representative trim the bruised area to determine if it penetrates the underlying tissues. If a carcass has an extensive bruise which penetrates the underlying muscle tissue, it is rejected as unsound.

(2) Scores - The terms "cuts" and "scores" are considered synonymous. As a guide, "slight cuts and scores" are surface breaks which are not more than 2 inches long and do not penetrate the lean meat more than 1/2 inch from the point of entry. This interpretation applies regardless of where the score or cut is located.

(3) Contamination - Each carcass is closely checked for evidence of rail rust, sawdust, and fecal contamination. Certain unsanitary conditions may not always be noticed by the Government inspector in the processing establishment.

3. Dressing of Veal and Calf - Most veal is dressed with the hide left on the carcass until it is thoroughly chilled. The carcass is split along the median line from tail to throat. The pelvic bone is split. The head and feet are removed. The carcasses are placed in the cooler, with the hides on. The dressing percentage is between 50 and 70 percent of the live weight.

a. Cold Skinning - The process of leaving the hide on veal and calf carcasses is also called "hog dressing" because the skin remains through chilling in all porcine dressing. The skin acts as a natural shroud by molding fat, firming up the flesh, and preventing contamination. Veal and calf have high moisture content, and cold skinning also prevents normal moisture loss or shrinkage during chilling. With very little external fat covering, the lean tissue of these carcasses would become discolored and dehydrated if the skin was not left on during chilling; thereby retaining the "bloom" or fresh appearance.

b. Hot-Skinned Veal and Calf - Carcasses that have finish that resembles the finish of beef must be skinned on the killing floor. The process of hot skinning involves removing the hide on the killing floor as is done in dressing beef animals. Cold skinning, allowing the animal or carcass to cool out in the cooler with the hide on, is the common method of skinning. The USDA is required to inspect for grubs on the backs of calves. Inspectors require animals to be skinned out on the floor if grubs are found.

4. Grading and Grade Factors - Veal and calf carcasses are graded on a composite evaluation of three general grading factors; conformation, quality and finish. These factors are given the same proportionate value in grading veal and calf as they are in grading beef carcasses. They are concerned with the proportions of the various wholesale cuts in the carcass with special emphasis given to the fleshing of those areas that provide the most valuable cuts. The standards have defined the grades of Prime, Choice, Good, Standard, and Utility, and the military equivalents of A through E based on the grading factors.

a. Conformation - Conformation refers to the general form, build, shape, or outline of the carcass, with special emphasis on the amount of flesh in those areas such as the legs, loins, and ribs which are the more expensive cuts. The best conformation involves a blocky compact body, short shanks, thick, full, plump rounds, a well-developed and broad back, thick shoulders and flanks, and a short, stocky neck. Ideal conformation is found in the beef breeds.

b. Quality - Quality of meat refers to its indicated palatability. It is evidenced by the texture, firmness, and color of the flesh. These factors are most obvious in exposed muscle surfaces, such as, the gracilis muscle, fold of the flank, rib muscle, and the brisket. The color is most important because of the variation of this factor. If a carcass is chilled too slow, for example, the color will be darker in color. There are other

factors influencing color, such as, the age, diet, and resting prior to slaughter.

c. Finish - Finish is the amount, character, and distribution of fat in a carcass. The nubbin consists of the prefemoral lymph gland and its surrounding fat and is used as one indicator of finish. It is located in the fold of the flank and can be felt in unskinned animals also.

(1) Internal Fat - The higher grades usually have moderately large deposits of fat in the pelvic region and around the kidneys, flank, breast, and crotch. Feathering and marbling are not expected except in the larger, well-fed calves.

(2) External Fat - The top grades of veal call for a thin covering of fat over the rump, loin, back, and shoulders. In young, lighter animals, the covering is softer, more pliable, and thinner. In older animals, it becomes harder, flakier, and much heavier or thicker. The amount of external pelvic and kidney fat is given no consideration in Prime and Choice grades.

(3) Lack of Fat - The lack of fat in veal and calf carcasses is called a "burned out appearance." Cold weather and undernourishment cause this condition. It is a lack of internal fat, and the fat that does exist appears dark brown. This appearance of fat is particularly noticeable around the kidneys.

SECTION I - LAMB INSPECTION

1. Market Classes of Ovine - There are five market classes of ovine and the dividing factor is age. The time of year an animal is born and the approximate age at the time of slaughter designate the market classes. The Government procures lamb only, and these animals are in three market classes. The primary consideration for acceptance will be the presence of a breakjoint only found in lamb carcasses.

a. Lamb - Lamb is differentiated from yearling mutton and mutton on the basis of differences in the development of their muscular and skeletal systems. Lamb carcasses are from animals that are from 12 to 14 months old. Lambs always exhibit a breakjoint on both of their front shanks, always show narrow red rib bones, and always have lean meat of fine texture and a light color. The breakjoint is usually reddish and feels velvety to the touch.

b. Spring Lambs - In the late spring and early summer, the market receives lambs born the previous year and lambs born during the current year. Lambs born within the year are termed "spring lambs"; those born the previous year are termed "lambs". The term "genuine spring lamb" is applicable only to new crop lambs slaughtered from 1 March to the end of the first Monday in October.

c. Hothouse Lambs - Hothouse lambs are marketed before spring lambs. These lambs are force-fed on grains, raised in confined quarters, marketed at 6 to 10 weeks of age, and weigh from 30 to 40 pounds (live weight). They are usually marketed during the Easter season.

d. Yearling Mutton - Yearling mutton is derived from animals which are from 12-14 to 20-24 months old. This mutton may have a breakjoint and/or a spool joint on one front shank. The breakjoint in yearling mutton is rougher and shows less color than the breakjoint in lamb. It shows some signs of calcification. The rib bones are moderately wide and have only traces of red. The color of the lean is slightly dark red; the texture of the lean is slightly coarse.

e. Mutton - This meat is from animals which are 20 to 24 months old or older. Mutton carcasses always exhibit spool joints on their front shanks. The ribs and shanks are devoid of red, the ribs are wide, the lean is dark red, and the texture is coarse. The external fat covering tends to show areas of patchiness in the tail region and over the shoulders.

2. Age Determination - In other animal and carcass inspection besides lamb and mutton inspection, class refers to sex. In lamb and mutton inspection, class refers to the age of the animal from which the carcass was derived. In determining age, several factors are considered. These are breakjoint, mouthing, the color of the lean, body contour, and outer fat covering.

a. Breakjoint Method - This method is used only as a determining factor after the color of the lean meat indicates that the carcass is lamb. The breakjoint is formed at the metacarpal-epiphyseal junction (at the joint where the front feet are removed).

(1) Yearling Mutton - In yearling mutton, the tooth-like projections of the breakjoint are not as well-defined nor as pronounced as they are in lamb carcasses. Because of ossification, it is not likely that breakjoints will be found on both legs. Usually one breakjoint and one spool joint are found.

(2) Mutton - Mutton carcasses never exhibit a breakjoint. Spool joints are found on each front shank.

b. Mouthing - The mouthing examination is performed on the killing floor. The first and second pairs of incisors are examined; if they are worn, the carcass is classed as mutton. This method is of no significance to the military veterinary service in the CONUS, but it may be used in inspections in overseas areas.

c. Color of Lean - The color of the lean is the most important factor in ascertaining the age of the animal from which the carcass was derived. It is determined by examining the flank muscles. As the animal becomes older, the lean tissue becomes much darker red.

d. Body Contour - Body contour is not an entirely reliable factor for judging maturity. However, certain aspects of conformation are associated with maturity. As an animal matures, there is a tendency for it to have a spread through its forequarters and a barrel-shape through its body.

e. Outer Fat Covering - The outer fat covering of lamb carcasses is rather evenly distributed. In older animals, fat tends to become unevenly distributed and patchy over the loin, pelvic, and neck regions.

3. Grades and Grading Factors - Lamb grading is similar to beef grading. The desired conformation is a blocky, compact, and thickly fleshed carcass. Quality is the relationship of maturity to color, texture, firmness and marbling of lean meat. External finish is less important in grading lamb than in grading beef. The USDA quality grades based on these factors are Prime, Choice, Good, Utility, and Cull and the military grades are A through D.

a. Conformation - Ideal conformation is an animal with good muscling in the shoulders, ribs, loin, and rump. The animal will exhibit a high ratio of lean to bone with high percentage of the total weight being comprised of the more expensive cuts. The spread of the shoulders is an indication of quality, but rather than being barrel-shaped through the abdominal region, the carcass should be smooth and taper into a plump leg.

b. Quality - The overall excellence of a lamb carcass is evidenced through the firmness of the lean and marbling exhibited. The firmness of the flesh can be determined in the flank muscle. Although finish is not a grading factor, higher quality grades of lamb will exhibit marbling, feathering, and streaks of fat in the flank muscle. Tigering, which is strips of lean between the pelt and external finish, is also evidence of high quality carcasses.

4. Style - Lamb carcasses are prepared in three styles for the military. Style I is the whole carcass and it is available in four weight ranges. Style II is the whole carcass fabricated into telescoped lamb, which is also available in four weight ranges. Style III consists of wholesale market cuts of lamb which are normally procured.

a. Legs - The legs are both back legs remaining in one piece after they have been separated from the double loin portion. This is done by cutting straight, across, and through the unsplit hindsaddle at right angles to the chinebone at a point forward and adjacent to the hip bone.

b. Loin - The loin is both loins remaining in one piece as a pair after it has been separated from the double leg portion at the junction of the hip bone. The flank is removed and exhibited from the untrimmed loin at a point on the 13th rib not more than 4 inches from the point

of the loin eye muscle in carcasses weighing 55 pounds or less. For carcasses over 55 pounds, this point on the 13th rib is not more than 4 1/2 inches. The cut is continued in a straight line to a point on the leg end of the loin not more than 4 1/2 inches from the hollow of the last posterior chinebone.

c. Back - The back is the unsplit hotel rack (middle section of the carcass) and the double loin of the unsplit carcass remaining after the legs and double chuck are removed. It is trimmed to exclude conventional stewing portions. It contains the 5th through the 13th ribs.

d. Hotel Rack - The hotel rack is the cut remaining after separating the double chuck portion and extending the cut at right angles to the spine from the 5th to the 12th ribs. The breast portion is removed by starting at a point 4 inches from the rib eye at the 12th rib to the 5th rib at a point not more than 4 inches from the hollow of the chinebone in carcasses weighing 55 pounds or less and 4 1/2 inches in carcasses weighing over 55 pounds.

e. Chuck - This comprises the anterior portion of the foresaddle. It includes all of the first through the fourth ribs, both shanks and briskets and the neck.

f. Shoulder - The shoulder is derived from the four-rib double chuck by cutting in a nearly straight line starting at a point on the fourth rib not more than 4 inches from the hollow of the chinebones on the inside of carcasses weighing 55 pounds or less and 4 1/2 inches on carcasses weighing over 55 pounds. The cut passes through a point at the forward end of the first segment of the sternum or breastbone. This separates the shoulder from the brisket and shank portions and exposes the cross-cut section of the round armbone. The neck is removed at the third cervical vertebrae, and the neck, brisket, and shanks are excluded from the shoulder.

g. Breast and Shank - The breast and shank comprise the breast and shank portions left intact with the shank attached as a unit, as removed from the shoulder.

h. Telescoped Lamb - After a lamb has been slaughtered, a cord is passed around its foreleg as near the knee joint as possible, over the top of the first cervical vertebrae of the neck, and around the other foreleg. The cord is pulled tightly to force the forelegs in a line parallel to the back bone. The neck is drawn downward and foreward. After the carcass is chilled, the lower foreshanks are removed at the knees and the hind legs are separated from the carcass by cutting perpendicularly to the chinebone in front of and close to the hipbones. The lower hind shanks are removed from the legs at the hock joint. The hindlegs are placed inside the body cavity of the carcass and forward into the chest cavity. A needle with a strong cord is inserted through the flank on one side and then through the other flank. The cord is pulled

tightly and a tie is made. The telescoped carcasses are frozen in a wind tunnel or sharp freezer.

5. Inspection of Lamb Carcasses - The carcass must always be inspected for the presence of a breakjoint. If a shank has been removed in such a way that the breakjoint cannot be seen, the carcass is assumed to have had a spool joint. Weight ranges and styles must be observed to determine conformance with a contract. The evidence of contamination by fecal material or slime will be cause for rejection. The fell membrane, a parchment-like cover on the lean surface, may exhibit water blisters. These water blisters are a result of high pressure water hoses and may add to slime conditions.

SECTION J - PORK INSPECTION

1. Specification Terminology - The specification divides packer style pork carcasses into two basic styles. The packer style carcass is split down the vertebrae and the heads, pluck's, (liver, heart, lungs), kidneys, ham facings, and leaf fat, as well as nearly all lumbar, pelvic, and heart fat and mediastinal tissue are removed. Shipper style is the alternative method of dressing a carcass, which the military does not procure. These carcasses are unsplit with the head remaining attached.

a. Style A - This style is hog carcasses split in half (two equal sides) and should be barrow and gilt carcasses. The hogs are slaughtered and their carcasses prepared in establishments operated under the supervision of the USDA.

b. Style B - The commercially prepared wholesale market cuts of pork comprise this style. The raw materials should be well chilled pork derived from packer style dressed hog carcasses.

2. Grades - Pork carcasses are quality graded on the basis of conformation, quality, and finish. The conformation of pork is the amount of high value cuts, but this is exhibited in plump hams, thick shoulders, and a long, high arched back. Pork does not need the blocky conformation of beef to grade in a high quality grade.

a. Quantity of Fat - The amount of finish is reflected in conformation and marbling is not a factor in pork. The fat should be abundant and in proportion to the weight of the cut in the best quality pork. More fat is permitted on heavier cuts in high grade pork; however, excessive fat lowers quality.

b. Character and Consistency of Fat - After the carcass is chilled, the fat must be firm and have an opaque appearance. The fat of good pork is white and hard at storage temperatures. Hogs fed on feeds such as oleaginous foods and garbage yield fat which is soft, oily, and has a low melting point. Certain pork may be so soft and oily that the carcass continues to drip oil after the animal has been slaughtered.

c. Quality - Quality concerns the texture of the muscle fibers and the fineness of the bone. It is an indication of the eating characteristics of the carcass or cut. The color of the flesh should be light red or pinkish gray. Bones must be fine and soft, and must have some red color. The skin should be smooth and free of hair roots, bruises, and discolorations.

d. Grades - The USDA grades are US No. 1 through 4 and Utility. The military will buy the best available selection.

(1) US No. 1 - Slaughter hogs which have a minimum degree of finish and yield high-quality pork cuts. The carcasses have a relatively high ratio of lean to fat and yield more than 50 percent of their weight in the major lean cuts; hams, loins, picnics, and Boston Butts.

(2) US No. 2 - Hogs which are slightly fatter than necessary to produce high-quality pork; the cuts require considerable trimming. These carcasses normally yield from 47 to 50 percent of the major lean cuts.

(3) US No. 3 - Overfat hogs which yield a low proportion of lean cuts and a high proportion of fat. The yields of the lean cuts are usually less than 47 percent.

(4) US No. 4 - Carcasses in this grade have an acceptable quality of lean but a lower expected yield of lean cuts than carcasses in US No. 3.

(5) Utility - These are all carcasses which exhibit lesser developments of lean quality than the minimum described for the first four.

3. Wholesale Market Cuts - After hog carcasses are thoroughly chilled, they are delivered to the cutting room where they are broken up or divided into market cuts. Proper chilling is important to facilitate handling them. Pork carcasses are usually chilled for 24 hours after hogs are slaughtered; then they are cut. Accurate cuts depend on thorough chilling. Cuts formed from hot carcasses may become distorted from shrinkage. The temperature of the cutting room is usually around 40° to 50°F. In cutting a pork carcass, each side is divided into the anterior, middle, and posterior portions.

a. Posterior Portion - As the chilled carcass arrives in the cutting room, the skin attachments between the two sides are severed and the gambrel cord is cut, permitting the sides to drop separately on a moving conveyor line. The posterior is removed first. This portion is formed by cutting on a line perpendicular to an imaginary line drawn through the center of the shank to the tip of the aitchbone. The perpendicular line should be 2 1/4 to 2 3/4 inches below (anterior to) the aitchbone or about the width of three fingers. Upon reaching the pocket of the flank, the cut is diverted backward at an angle of 45°. The posterior portion is then divided into three parts; the ham, tail and foot.

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(1) Ham - The ham is formed from the posterior portion by removing the tail and foot. The tail is removed in such a manner as to make a rounded ham. The foot is removed at or above the hock joint so the marrow is not exposed. When the foot is properly removed, a "star-like" formation, called a star joint, can be noted on the shank end. The ham constitutes about 13 percent of the carcass. There are several types of hams formed, either by removal from the side by trimming the skin or by removing the shank.

(a) Regular Ham - A regular ham is a ham that has its skin left on. The foot is neatly sawed and cut off at about right angles to the shankbone in or slightly above the hock joint, toward the body of the ham. Unless otherwise specified, hams with the shankbone marrow exposed are acceptable. The caudal vertebrae and tail must be removed. Practically all pelvic fat and loose fat on the face of the ham must be removed without any appreciable scoring or damage to the muscular portion or the major arteries used for pumping and curing. The hams must be suitably faced without ragged edges and with a smooth, well-rounded skin collar on the face side not extending more than about 2 1/2 inches inward from the stifle joint juncture on a line therefrom to the bone at the butt end and properly flanked to remove the glands, fat, and tissue close to the major lean meat of the flank. The ham should be closely and shapely trimmed and well-rounded at the cushion and butt end so it is relatively short, thick, plump, and uniformly smooth. The exterior fat thickness of a trimmed regular ham, measured under the bone at the butt end, must meet the following requirements:

Weight of Ham	Minimum	Maximum
10-12 pounds	3/4 in.	1 1/2 in.
12-14 pounds	7/8 in.	1 3/4 in.
14-16 pounds	1 in.	2 in.

(b) Short Shank Ham - A short shank ham is a ham that meets the requirements of a regular ham, as outlined in the paragraph above, except that about half or more of the shank (not beyond the stifle joint) is neatly sawed and cut off and excluded. The shank portion should be cut off at about right angles to the main (tibia) shankbone of the ham.

(c) Skinned Ham - A skinned ham is a ham that meets the requirements of a regular ham, as outlined in (a) above, except that it is partially skinned on the back, leaving a neat, well-rounded skin collar at the shank end. The skin collar must not be more than 45 percent of the entire back (skin side) surface of the ham, measured lengthwise from the approximate center at the edge of the butt to the extreme outer tip of the shank end when removed at or near the hock joint or not more than 15 percent of the distance from the center at the edge of the butt to the stifle joint. The skin is removed so the collar line slants downward 15° to 18°, starting at the cushion side. Fat remaining on the skinned surface should be fairly smooth and should be reasonably uniform in

in thickness, not more than one-half of an inch deep, measured at points extending 1 1/2 inches inward from the edge of the skin collar. The fat should be neatly beveled on the back so that it approximately meets the lean meat at the butt end.

(d) Skinned, Short Shank Ham - A skinned, short shank ham is a ham that conforms to the requirements for a short shank ham and a skinned ham.

(e) American Short Cut Ham - The ham cut, as outlined in paragraph 3a, is commonly known as an American style or short cut ham.

(f) Long Cut Ham - If the posterior portion is removed from the side at a point 7 inches anterior to the aitchbone on an imaginary line perpendicular to a line drawn through the shank to the aitchbone, it is commonly known as a long cut ham. These are rarely seen today.

(2) Foot - When the foot is properly removed, a star joint is formed. If the marrow is exposed, it affords an excellent opportunity for contamination and early deterioration of the ham. Exposure of the bone marrow, however, is not a rejection factor, unless the contract specifies otherwise. The small extensor muscle is removed from the anterior surface of the foot, pickled and canned and sold as a delicacy. The remainder of the foot is usually tanked; however, if the foot is properly cleaned, the USDA will allow it to be used in pickled pig's feet.

b. Middle Portion - The middle portion is formed by removing the anterior portion from the remainder of the side. A cut is made by a large circular saw on a line perpendicular to the chinebones, leaving not less than one nor more than two and a half ribs on the anterior portion. The loin, spareribs, fatback, and belly are derived from the middle portion.

(1) Loin - The loin is the first cut removed from the middle portion. A cut is made with a small circular handsaw through the ribs on a fairly straight line running parallel with the major loin muscles starting at a point on the first rib of the loin about 1 1/2 inches from the junction of the foremost rib and the foremost thoracic vertebra to a point at the ham end which is adjacent to the major tenderloin muscle. The term applied to this cut is "scribing." After the ribs have been scribed, a "U"-shaped knife is then placed under and drawn beneath the loin separating it from the fatback. The term applied to the removal of the loin from the middle portion is "scribing and drawing."

(2) Spareribs - A spareribs is the entire intact rib section as removed by neatly "ribbing" the belly portion of the pork carcass midsection extending from the scribe line at the fatback side of the belly, to and including portions of the lower rib cartilages, and with or without a portion of the split breastbones and with the major diaphragm

remaining. Loose fat should be closely removed. The spareribs should contain all except the first, second and third rib bones. To allow for cutting variations, the second and third ribs may be included as a part of each spareribs when normally attached. The weight range for spareribs is usually 3 pounds and down. A 3 to 5 pound weight range may be procured; however, this usually happens when the 3 pound and down range are scarce and prices are prohibitive.

(3) Fatback - The fatback is the fatty layer formed by removing the loin and belly from the middle portion. After the loin is removed, the remaining portion is further cut by a large circular saw longitudinally on a line which is about 3/4 to 1 1/4 inches above the scribe line, forming the fatback and the belly. Fatbacks are seldom purchased as such; they are usually put in dry salt cure and sold mainly in the southern regions of the United States as salt pork.

(4) Belly - A belly is known as a belly until it is cured and smoked. After it has been cured and smoked, it is known as a bacon. The belly is formed by its removal from the fatback as mentioned above, and after the spareribs have been removed. Bellies should be commercially square cut at both ends and have all semi-loose pieces removed. The belly should be free from flesh scores or scribe cuts exceeding 1/4 inch in depth.

c. Anterior Portion - The anterior of the carcass is the portion that remains after the middle portion has been removed. About one to two and a half ribs are left on the anterior portion. Several cuts and combinations of cuts are formed from the breakdown of the anterior portion.

(1) Shoulder - A regular shoulder (skin on) is formed by separation from the standard hog side by cutting reasonably straight across and approximately parallel with the ribs so that not less than all of the first rib and not more than two and a half ribs (lower thorax ribs) are left on the shoulder with the cut made at a point in the armpit beyond and without exposing the elbow joint. The neckbones, ribs, and related cartilages, intercostal meat, breast flap, and loose ends are closely and smoothly removed. The shoulder is well-faced without scoring or undue removal of lean. The front foot is neatly sawed and cut off in or slightly above the upper knee joint, at right angles to the shankbone, toward the body of the shoulder. Unless otherwise specified, shoulders with short shanks (not cut beyond the elbow joint) are acceptable. The jowl is removed close to the body of the shoulder on a line approximately parallel to the opposite straight cut-side of the shoulder starting behind the "ear-di[illegible], which will remain on the jowl and continuing the cut to the terminus on the edge at the breast end, so that the entire jowl section is removed. The overhanging or protruding skin or fat at the butt should be closely removed to a slight bevel approximately meeting the major lean meat edge at the butt to produce a closely and shapely

trimmed regular shoulder. The external fat thickness of trimmed regular shoulders measured at the approximate center of the butt should conform to these requirements:

Weight Range of Shoulders	Minimum	Maximum
8-10 lbs.	3/4 in.	1 1/2 in.
10-12 lbs.	7/8 in.	1 3/4 in.
12-14 lbs.	1 in.	2 in.
14-16 lbs.	1 1/4 in.	2 1/4 in.
16-18 lbs.	1 1/2 in.	2 1/4 in.

(2) Short Shank Shoulder - A short shank, regular shoulder is a shoulder that conforms to the requirements for a regular shoulder as outlined in the preceding paragraph, except that about half or more of the shank (not beyond the elbow joint) is neatly sawed and cut off at right angles with the shankbone, or about parallel to the knee joint.

(3) Skinned Shoulder - A shoulder that conforms to the requirements for a regular shoulder except that it is partially skinned, leaving a well-rounded skin collar at the flank end. The skin collar should not exceed 45 percent of the entire back surface of the shoulder, measured lengthwise from the approximate center at the edge of the butt to the extreme outer tip of the shank end when removed at or near the upper knee joint or not more than 25 percent of the length, measured centrally along the back of the shoulder on a straight line starting at the juncture of the elbow joint to the edge at the butt end. Fat remaining on the skinned surface should be fairly smooth and, except for beveling at the collar and butt ends, reasonably uniform in thickness, not exceeding one-half inch in depth, measured at points extending from 1 1/2 inches inward from the skin collar to the inner bevel edge at the butt end. At least traces of false lean must be in evidence on the back surface of the shoulder. The fat should be neatly beveled back from a point close to the lean meat edge at the butt and sides.

(4) Picnic - The picnic is the approximate lower half portion of the skinned shoulder after separation from the shoulder butt. The separation must be reasonably straight and perpendicular, made parallel to the breast side of the shoulder, leaving all of the major shoulder bone, the connecting bladebone joint, and from 1 to not more than 2 inches of the blade bone remaining intact in the shoulder picnic. The foot is neatly sawed and cut off in or slightly above the upper knee joint at right angles to the shankbone end. Unless otherwise specified, picnics with short shanks (not cut beyond the elbow joint) are acceptable. The picnic should be well-faced (the lip and breast flap should be removed), and well-rounded, with the skin and fat beveled to at least the thickness of the fat at the butt end so it produces a closely and shapely trimmed picnic.

(5) Boston Butt - The slightly wedge-shaped portion of the pork shoulder after separation from the standard cut picnic, as mentioned in the previous paragraph. The neckbones, bloody portions, and loose ends

are closely and smoothly removed without deep scoring or mutilation of the flesh. The major bladebone portion remains intact in the butt. The skin and the underlying fat that is more than one-fourth of an inch thick over the main body of the butt should be smoothly and uniformly removed to expose the false lean or "seam meat" on the back or skin side. The fat should be neatly beveled so that it approximately meets the major lean flesh at the edge on all sides.

(6) Clear Plate - The layer fat and skin removed from the outside (skin side) of the regular shoulder.

4. Defects - Fresh pork is very susceptible to decomposition and spoilage because of the action of microorganisms and the oxidation of tissues. Because of its susceptibility to spoilage, it is especially important to check fresh pork for bruises and rancidity.

a. Bruises - Bruises are areas of flesh infiltrated with blood. Injuries are the cause of bruises. Those bruises which involve only the skin are considered minor, but those involving fat and lean are major defects. Cuts showing bruises in fat and lean tissue cannot be accepted by the military.

b. Rancidity - The major cause of rejection of pork products is oxidative or hydrolytic rancidity. There is an unstable fat constituent in pork which combines with oxygen to cause oxidative rancidity. To prevent this, fresh pork should be wrapped or not stored any longer than necessary. Cured pork products have antioxidants added to prevent oxygen from combining with the fat constituent. If pork is stored at temperatures above 40°F, an enzyme called lipase is produced by bacteria and will combine with moisture to produce hydrolytic rancidity. The best preventative for hydrolytic rancidity is storage temperatures of less than 40°F.

c. Hair Roots - This indicates poor workmanship during the dehairing process. In most wholesale cuts, the skinning required will prevent this defect, but some cuts such as bacon bellies, frequently exhibit hair roots.

d. Seeds - These are the mammary tissue of pork bellies. When these seeds are white this indicates the carcass is from a gilt and the mammary gland has never been active. When the seeds appear red, it is indication of their having been active on a sow. When the seeds are black, the indication is a belly from an old sow.

e. Odors - Pork products which emit any type of foreign odor are unsatisfactory. Cuts derived from old stags and boars have a distinct sexual odor.

f. Color - Fresh pork is bright gray-pink and uniform in color. Old hogs yield a carcass with darkened color. A carcass with dark color or deposits of pigment on its skin surface is cause for rejection on procurement inspections.

5. Inspection of Ham and Bacon - Bacon usually means the cured and smoked bellies of hogs; however, in some countries the term refers to any cured and smoked pork product. A ham is the thigh of an animal prepared for food. There are regular hams which have a covering of skin and fat over the entire back, and there are skinned hams which have skin removed from the back down to within four inches of the shank.

a. Bacon - The quality of green fresh bellies is indicated by the color and the texture of the skin, the fat, and the lean. A high-quality belly should be smooth and flexible and free of bruises, cuts, wrinkles, coarseness, and discoloration. The fat portion should be white and firm. The lean should have a red color and should be of fine texture. The good features are influenced by good feeding and breeding. Hogs fed on grain yield a firm white fat. Meats with a firm white fat chill readily and are easily trimmed into cuts which retain their shape. Hogs fed oily feeds such as soybeans, peanuts, and acorns will produce a brown fat that is soft and oily in texture and is not acceptable for military use.

(1) Defects in Bacon - A common defect seen in bacon is bruising. Injury to a live animal while it is being transported or in handling it before it is killed may cause this defect. During the bleeding of the slaughter operation, the blood of bruises is entrapped in the tissues. Sometimes bruises are not visible in the green uncured belly but become very apparent after curing and smoking. Bruises are a defect because they detract from a product's appearance and because the affected area is subject to spoilage. Other defects are scribe cuts, presence of black seeds, presence of bone, hair roots, unsmoked areas, and mutilation in handling.

(2) Inspection Procedures - When inspecting bacon, use the trier from the food inspection kit. Three landmarks for making the trier inspection are the flank pocket, the featherbone line, and the brisket end. Off-odors, rancidity, and slime should be checked when a trier inspection is performed. You should follow the same practice that is followed in inspecting other foods and check purchase orders and their supporting documents which cover bacon in order to make sure it conforms to all terms of the contract. Slab bacon is usually bought in two weight ranges; an 8 to 12 pound range and a 12 to 14 pound range. The amount of fatback removed should not exceed 1 1/4 inches from the scribe for a lot average. A bacon slab should be at least three-quarters of an inch thick at any point except the edges. The leaf fat and excessive cartilage should be removed; the slab should not have unsmoked areas, hair roots, mutilations, or black seeds.

(3) Specification for Bacon - The current specification (PP-B-81) distinguishes two primary types of bacon. Of these two types, only Type II (special) is procured for military use. Type I (standard), which is not purchased by the military, is basically a commercial product. Included under Type II bacon are several forms, styles, and classes.

(a) Type II (special) - Form A refers to slab bacon and Form B refers to sliced bacon. Type II will usually be one of the following three styles. Style 1, one (or) slab, unsliced or reformed, wrapped in wax paper; Style 2, one pound units not vacuum packed; Style 3, one pound units partially vacuum packed. The three classes of Type II bacon are: Class 1, chilled; Class 2, frozen/domestic; Class 2A, frozen/domestic. Inspectors should be alert to new changes and amendments to the specification.

(b) Requirements for Type II - Uncured bellies for Class 1 (chilled) and Class 2A (frozen/domestic) may be frozen provided they have been stored at 0°F or below for less than 60 days. Total time in the smokehouse shall be 18 hours or more. Smokehouse temperatures may vary but shall not exceed 120°F during the entire period. Class 1, within 48 hours after smoking, shall be placed and held at 40°F or lower. Classes 2 and 2A shall be placed in a freezer (0°F or lower) within 96 hours after completion of smoking.

b. Quality of Hams - The ham quality determination factors of skin, fat, and lean are much the same as the factors in bacon. However, for hams, bone becomes a very important factor. The bone must not be excessively large nor excessively hard and white. Cut surfaces of the aitchbone of a young animal are cartilaginous or red, while the cut surfaces of this bone of an older animal are white and flinty. The meat from the ham of an old animal is likely to be tough. The skin should be smooth, soft, firm, and unwrinkled. The lean should be firm and have a good color. The fat should be white and not excessive. The smoked product should be brown and smooth.

(1) Inspecting Shank - A primary off-condition to check for in hams is souring. The most common area for souring is in the shank end of the ham where the bones of the thigh, knee, and two lower leg bones are located. These bones are surrounded by tendons and fibrous material. It is difficult to penetrate these areas adequately with curing agents. When these areas are not adequately cured, bacterial growth may be stimulated during the smoking period and souring may result. A trier can detect this condition.

(2) Examining Butt End - The fat on the aitchbone, the marrow of the femur, under the aitchbone along the femur, and in the stifle joint should be checked with a trier. Pelvic fat is very unstable, and if any remains on the aitchbone, souring is possible.

(3) Using the Trier - The trier is an instrument resembling an ice pick which is used to probe areas for sourness. It should be clean and free of any odors which may interfere with the examination. It is inserted into the areas mentioned above, then withdrawn and held under the nose to detect the odors of sourness.

(4) Inspecting for Bruises and Mold - Bruises are as undesirable in hams as in bacon. The injured tissue must be trimmed away. Surface mold is not toxic and can be washed off with vinegar and water. If the mold growth is not inhibited, it may penetrate cracks throughout the ham. Molds are not toxic on meats, but there is an undesirable flavor present.

SECTION E - CURED AND SMOKED MEATS

1. Definition of Curing - Curing is a method of preserving or imparting a particular flavor to various meat products. Meat was originally cured in order to preserve it. The need to cure meat for this purpose is not as great today as it originally was because refrigeration is now available. Consumers have the same eating habits they had before refrigeration was developed, and they still demand the flavors and colors of cured meats.

2. Curing Agents - Many curing agents may be used for the curing process. The function of each is separate, but the result is preserving the quality and consumer acceptance of the product. Salt is the basic curing agent, but it may be supplemented with other agents, such as sodium nitrate, sugar, spices and many other supplementary products. The primary objective in curing meat is to prolong its keeping quality. This is done by saturating tissues with salt which eventually destroys most of the microscopic organisms. The salt does not destroy all pathogens; the curing process will not make trichinae-infested pork safe. There are agents for stabilizing the color, counteracting the brackishness of salt, and preventing oxidation. Regardless of the agent, the consumer is protected by USDA supervision of the quality and quantity used in each product.

a. Salt (NaCl) - Salt used in the curing formula may be used alone or with other ingredients. Salt is basically a preservative; it extracts moisture from meat and imparts flavor. The concentration of salt in cured ham is from 2 1/2 to 4 1/2 percent and in cured bacon from 3 1/2 to 4 1/2 percent.

b. Sugar - The preserving characteristics of sugar are similar to those of salt, however, sugar does not have these characteristics to the extent that salt does. Sugar adds flavor, removes some moisture, tones down the brackishness of salt, and furnishes food for desirable bacterial growth in the curing process. Excessive amounts of sugar do not enhance the keeping quality of meat, but they may cause it to turn dark red.

c. Nitrates - Sodium nitrate and potassium nitrate act as reservoirs for nitrites and increase the permeability of meat fibers for water.

d. Nitrites - These are produced from the reducing bacteria acting on sodium or potassium nitrate. Nitrite unites with hemoglobin or myoglobin to form nitric oxide myoglobin which, in the presence of heat, yields nitric oxide myochromogen (a stable color). Nitrite salts may be added to the nitrates to insure having enough nitrite for color fixation. The quantity of nitrites added must be carefully controlled by the USDA to avoid creating toxic effects.

e. Other Additives - Spices are added for flavor; they have no curing properties. Such antioxidants as ascorbic acid, sodium ascorbate, or sodium isoascorbate may be added. The ascorbates accept oxygen and keep it from combining with meat pigments, thus preventing purplish or brown discoloration. Chemicals known as polyphosphates are also used to retain or promote color development.

3. Curing Methods - The fundamental procedures to follow in handling meats before they are cured are refrigeration, preferably below 40°F, to insure that lipase, a rancidity enzyme, is destroyed and to inhibit bacterial growth and oxidation. Another consideration is sanitation. Good sanitary practices reduce bacterial contamination and bacterial growth. The three principal methods of curing fresh meats are with dry salt, by drybox, and with pickle.

a. Dry Salt Curing Method - This method involves applying salt without other agents to the surface of the meat. After the cuts are rubbed or sprinkled with salt, they are placed on racks and additional cuts are stacked on these with a layer of salt between the cuts. After several layers have been stacked, the salt is spread over the exposed areas of the stack and it is left to cure at a temperature below 40°F and in subdued light. Curing takes several weeks. During this period, "overhauling" is necessary. This is a restacking of the cuts so that those which were on top are placed on the bottom of the new stack and those which were on the bottom are placed on the top. Overhauling equalizes pressure on the cuts to allow a more equal rate of salt absorption and reduces the possibility of rancidity by placing the cuts which were initially exposed to the air on the inside of the stack. During the curing, moisture is extracted from the tissues and the salt is dissolved in the tissue fluids. It is frequently necessary to add dry salt because of the concentration which is weakened by dissolving in the tissue fluids.

(1) Dry Cure - Dry curing is confined largely to fancy bacon bellies, boneless butts, canadian style bacon, briskets, sausage meats, and similar items. Fancy bacon bellies and briskets are cured in tight boxes; the other meats are usually cured in tierces. Boxes for curing fancy bacon bellies have a capacity of 500 to 600 pounds. While they are usually made entirely of wood, some establishments use a galvanized iron lining. Any box that is used must be watertight, and practically airtight to prevent loss of moisture and discoloration due to oxidation. Clean and sterile boxes which are about to be used are lined with oiled paper on their bottoms and sides. A definite quantity of bellies and a proportionate quantity of cure are weighed out for each box; the box is then loaded. Each belly is lightly covered with cure and placed in the box, skin down, in close contact with the others. This is continued until the box is nearly full, then the last layer is put on, usually skin up. To distribute the cure evenly, some packers weigh into individual containers the amount of the cure that is to be used on each layer of bellies. Oiled paper is put over the top layer and the box is closed.

(2) Modified Box Cure -- Large packers practice a modification of the box cure. The curing containers consist of rectangular wooden vats of varying capacities. The meat to be cured is rubbed with dry curing agents and carefully laid in the boxes; it is not packed as compactly as in fancy box curing. A loose-fitting cover holds the meat in position and the spaces between the cuts are filled with a mild pickle. This method is used to cure lightweight bellies that are not quite high enough in quality to meet the requirements for fancy bacon and too high in quality for the sweet pickle trade.

(3) Combination Cure - Some packers now use a combination cure for a limited quantity of meats. This consists of curing the meats for a time in pickle and finishing the cure in dry salt, or vice versa. Meats cured by this process are not as dry as dry salt meats nor as high in moisture as pickle-cured meats. The cure is largely limited to bellies.

b. Pickle Curing - The term "pickle" as applied to meat curing, means a solution of the curing agents. Plain pickle is simply a solution of salt in water. Compound pickle contains salt, sugar, and/or sodium nitrate and/or sodium nitrite. Pickle that contains sugar in some form is also known as "sweet pickle".

(1) Plain Pickle - Pure water and salt (usually crushed rock salt) are used. The salt is placed in large vats and water is run through it, either by being forced in at the bottom and overflowing at the top, or by gravitating through from the top and being drawn off at the bottom. The water passing through the salt becomes saturated and is drawn off at 100° strength. Any gross impurities in the salt are removed by straining the brine through fine copper screening, then through cloths, and finally filtering it through sponges. The 100° pickle is then drawn off into large holding vats where it is standardized to any desired strength by the addition of water. The pickle may or may not be sterilized, depending upon the purity of the materials used.

(2) Compound Pickle - In making compound pickle, the brine is reduced to the desired salt strength by adding water. A sterile solution of the other curing agents is added to this. The sugar, sodium nitrate, and sodium nitrite are dissolved in a vat in as little water as is necessary to put them in complete solution. Solution is hastened by boiling, which also sterilizes the solution. The solution is then added to the brine to produce pickle of the required strength and curing ingredients.

(3) Second Pickle - Pickle that has been used to cure meats is called "second pickle". During the curing process, the meat takes up from the pickle considerable quantities of the curing agents. Fancy ham pickle, for example, may be reduced from 70° strength as fresh pickle to 50° strength as second pickle. However, the remaining curing agents (particularly in compound pickle) are still usable and too valuable

to throw away. Likewise, the second pickle contains end-products of nitrate conversion and bacteria desirable for further curing operations. But second pickle also contains many soluble protein substances and inorganic meat substances, which are vulnerable to decomposition. These must be removed before the pickle can be used for further curing. Second pickle is prepared for reuse by bringing it to a temperature of 200°F, skimming off the scum produced by the coagulating albuminous substances, filtering, and bringing the remaining pickle to the desired strength by adding the proper quantities of salt and other curing agents. As a rule, only compound pickle from fancy grades of meat is reused. Second pickle contains about two-thirds of the original salt and sugar and one-half of the nitrate used in the original pickle.

(4) Ropy Pickle - When bacterial action causes pickle to become stringy and sticky and to have a fetid odor when it is warmed, it is called "ropy pickle". These conditions are caused by excessively high temperatures in the curing cellars, unclean vats, non-sterile pickle, contaminated or slimy meats, neglect of overhauling, and other factors. If ropy pickle is discovered early in the curing process, meat may be salvaged by promptly dumping the pickle, thoroughly washing the meat, sterilizing the vats with live steam, and re-covering the meat with fresh pickle. Meat allowed to remain in ropy pickle may spoil.

(5) Formulation - Pure water at 60°F weighs 8.34 pounds to the gallon at sea level and will dissolve 3.03 pounds of salt. This, however, will make more than a gallon of pickle. For general purposes, a saturated solution of salt in water is considered to contain 2.5 pounds of salt in a gallon or 25 percent by weight. The degree of saturation, or the intensity of pickle, is determined quickly by an instrument called a salometer. This instrument has a calibrated stem marked 0 at the point to which the salometer sinks in pure water and 100 at the point registered in a saturated salt solution; the intervening space is graduated in degrees. Some salometers are gauged between 0-40°, 40-70°, and 70-100°. They are made to read accurately at temperatures between 35° and 38°F. The degree of saturation or the strength of any pickle can be determined quickly with one of these instruments.

(6) Applications - The strength of pickle varies greatly with the purpose for which it is to be used. For curing purposes, pickle is designated as curing or cover pickle, and pumping pickle. Pumping pickle is invariably stronger than cover pickle since pumping is done to introduce the curing agents into the meat rapidly without introducing excessive amounts of water. Some establishments use pumping pickle of 100° salt strength plus other curing agents. Most packers, however, use pumping pickle of about 90° strength. Cover pickle varies in different establishments and in the same establishment with the kinds and grades of meat cured. Fancy hams, for example, are usually cured in pickle of 75° to 80° strength. In general, the milder the pickle the milder the cure. Most packers make two or more grades of hams; the highest or "fancy" grade is given the mildest cure. Nearly all curing pickle is "compound pickle."

(7) Pumping - Pumping is a term which describes a means of injecting a curing solution into the interior of meat. This is done by forcing the pickle (curing agents) into the meat through a needle under pressure. The two methods of pumping are the stitch or spray and the artery methods.

(a) Stitch Method - In stitch pumping, the needles are inserted into the pieces of meat in many areas, and several strokes per area may be injected. The amount of pickle introduced varies from 5 to 14 percent of the weight of the cut. Usually the quantity does not exceed 10 percent. Injection pumping, a variation of stitch pumping, is a mechanical means of injecting a predetermined amount of pickle into cuts passing on an assembly line.

(b) Artery Pumping - Artery pumping is generally used for hams. The ham is placed on scales with a graduated dial. The needle is inserted into the large artery near the stitchbone and pressure distributes pickle throughout the ham. An 8 percent increase in the weight of the ham is necessary to insure adequate permeation of the pickle solution. Hams can be pumped to an increase in weight of 20 percent, but in those cases, a light pickle concentration is used.

c. Overhauling - As explained earlier, overhauling is done to insure that all pork cuts are adequately cured. During the first week, much of the salt has dissolved in the meat juices and may be too diluted or it may have drained away. To insure adequate curing, dry salt-cured meats are rearranged and resalted on about the seventh day. Small cuts are overhauled only once, while large cuts with bones in them are usually overhauled on the seventh day, again in from 18 to 20 days, again in 35 to 40 days, and every 40 days until the cuts are shipped. Sweet pickle meats are overhauled earlier than dry salt meats. Bellies and small meats are overhauled at 3, 10, and 18 days. Long-cure hams and shoulders are overhauled at 5, 15, and 30 day intervals, and then every 30 days. Artery-pumped hams may be overhauled once or not at all. The same pickle is used; it is not strengthened.

(1) Barreled Meat - Meat packed in barrels in overhauled by rolling the barrel to stir the pickle and to loosen any close contact pieces of meat.

(2) Dry Cure - Dry cured meat is not overhauled because the pieces are small and the first cure is adequate.

d. Backpacking - This is a procedure of repacking meats which are nearly cured into tierces with a 25° pickle at a temperature of 0° to 15°F. While this does not completely arrest the cure, it does retard it. This procedure is used to store cured meats awaiting consumer demand. Pickle-cured meats may be withdrawn at the end of the cure and stored in racks under refrigeration. At 36°F, such cuts may be held for 2 weeks. At lower temperatures, the meats may be held longer, but they should not be stored for longer than 50 days.

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e. Gains and Losses -

(1) Dry Salt Cure - Loss of tissue fluids causes a loss of weight in this cure. Lean meat has the greatest loss because of its high moisture content. Large fat pieces of meat lose less moisture, because less moisture is extracted from the deep tissues.

(2) Pickle-Cured Meat - Pickle-cured meat (except pickled tongue) always show a gain in weight. The amount of this gain varies with the amount pumped, the class of meat, and the length of the curing period.

(3) Dry-Cured Meat - Dry-cured meat shrinks very little because none of the extracted moisture is drained, and because absence of air prevents evaporation.

(4) Loss of Nutritive Substances - There is a loss of such nutritive substances as albumin, phosphoric acid, potassium, salts, and meat bases. Cured meats have less nutritive value than the green cut from which they come.

f. Curing Other Meats - Certain cuts of beef are cured in the same way pork is cured. Since the processes are so similar, we will dicuss the curing of these beef cuts now, in this section dealing with pork and pork products. The beef products we will discuss are corned beef, beef hams, and beef tongues.

(1) Corned Beef - Corned beef may be prepared from any part of a carcass; usually the brisket and rump pieces are used. In preparing corned beef, the cut is rubbed with salt and the cuts are packed in layers. A 20 percent brine solution with sugar, nitrates, and nitrites is poured over the cuts. The beef is then stored for 25 days at about 36°F. During this period, it may be overhauled two or three times.

(2) Beef Hams - This is a term applied to cured rounds or parts of rounds. The rounds may be cured in a pickle containing salt, cane sugar and nitrate or they may be pumped by introducing pickle into their arteries. When the hams are cured by putting them in vats with the pickle, 100 days may be required to complete the cure. The cure may be shortened to 20 days with artery pumping. The beef hams are used for dried beef.

(3) Beef Tongues - The tongues may be cured by pickle or artery pumping. The cure takes 55 days in a pickle tank; it can be completed in 5 days if artery pumping is used.

4. Smoking - The objectives of smoking meat are to remove moisture to retard bacterial growth; to impart a desirable smoked flavor; to stabilize a cured color; to prevent oxidative rancidity; and to kill surface bacteria.

a. Smokehouses - Hickory chips and hickory sawdust are generally used in smokehouses. The heat is produced by steam coils inside the smokehouse. Temperature range from 120°F, necessary for color fixation, to 148°F, necessary for a "ready to eat" product. The older stationary smokehouse has many stories and is constructed of brick. The air and smoke circulate through natural current and uneven smoking and heating are common. The rotary type smokehouse prevents much of this problem by rotating the products

constantly during smoking. There are new conditioned types of smoke-houses called Julian smokehouses. They are totally air and smoke controlled to prevent uneven heat and smoke, and capable of washing the product after smoking.

b. Defects of Smoked Products -

(1) "Drips" - This is a condition of fluid drippings from the product on the higher trees. Excessive moisture in the cured product causes it.

(2) "Touchers" - This condition is recognized as a light-colored bald spot on the ham. This spot is subject to spoilage; it is caused by two hams touching one another, thereby keeping smoke from permeating all the outer surfaces of the meat.

(3) "Drys" - This is a dry condition of the smoked cut. Excessive heat in the smoking process causes it.

SECTION L - SAUSAGE

1. Classification of Sausage - There are two principal classifications of sausages; dry and domestic. These classifications are based on the way the product is processed. Sausages are meats which have been comminuted and further processed. Man developed types of sausages to meet the required conditions of temperature for preservation. In southern Europe, dry sausages were developed which would keep without refrigeration. In older climates, fresh and semi-dry sausages were developed. In this country today, about 13 percent of all meat from animals slaughtered goes into sausage making, which is the most profitable segment of the meat packing industry.

a. Domestic Sausage -

(1) Fresh Pork Sausage - This sausage is 100 percent pork meat, except for spices. The pork is ground through a grinder, and the spices are added. If the product is to be link sausage, it is stuffed or molded into casings. This product requires refrigeration, has limited shelf life, and must be cooked before it is served. Examples of this product are fresh pork sausage links and pork sausage, country style.

(2) Smoked Sausage - This is an all-pork product with spices added. The stuffed links are smoked with hardwood until they have the appearance and flavor of a smoked product. It has a longer shelf life than fresh sausage. It must be refrigerated for preservation and must be cooked before it is served. Examples of this sausage are smoked sausage links and Polish sausage.

(3) Smoked and Cooked Sausage - This sausage is made of fresh beef and pork. The purchase order specifies the percentage of each of

these ingredients. The meat components are mixed, ground, processed in a silent cutter, and stuffed into casings. The product is then cooked and cooked. It will have a good shelf life and is ready to eat. Examples of this type of sausage are frankfurters, bologna, and Vienna sausage.

(4) Cooked Sausage - The meat components for this type of sausage are fresh chilled pork livers, pork, and pork trimmings. Some contain blood or liver; these sausages have a short shelf life. All cooked sausage is ready to serve. Examples are liver sausage (Braunschweiger), tongue, and sliced loaf.

(5) Cooked or Baked Specialties - The meat components for this type of sausage are beef and pork or one of the components by itself. The components are mixed and ground, processed in a silent cutter, and stuffed into pans and molds for cooking or baking. The sausage loaves are dipped in hot oil to brown and glaze. This is a ready-to-serve sausage. Examples are pickle and pimento loaf, and baked ham.

b. Dry Sausage - Dry and summer sausages are found on the market under a variety of names. Many varieties originated in Europe. Each country has its own meat, spice, smoke, and coloring formula. Italian sausages are very highly seasoned, while northern European sausages are heavily smoked. The meat component for dry sausage must be of high quality. The pork used in dry sausages must be cooked to a temperature of 137°F, dried and cured in a high concentration of salt, or frozen to kill trichinae.

(1) Curing dry Sausages - After grinding and after spices and curing ingredients have been added, the meat is pressed into shallow pans. The pans are placed in a room with a temperature of 40°F for 24 to 72 hours. This is known as pan curing. The pans are removed; the meat is mixed for 2 to 3 minutes and the product is stuffed into casings. It is then given a cold smoke, which is a dense smoke with minimum heat. After smoking, the sausage is transferred to the drying room to finish processing with controlled temperature and humidity.

(2) Green Hanging - This is a more critical method of processing than the pan-curing method. The sausage is stuffed immediately after the grinding operation. The casings are transferred to a "green hanging room" where the temperature is held at 50° to 56°F and the humidity is from 55 to 65 percent. The sausage in casings is kept in this room for 24 to 72 hours. It is then smoked and transferred to the drying room. In this room, temperature and humidity are controlled by mechanical units which draw air through intake ducts and through a spray of water to remove dust particles and mold spores. The air is circulated over warming coils and into the drying room at a temperature of 50° to 60°F and a humidity of 65 to 80 percent.

2. Components of Sausage -

a. Beef - Beef is used in sausage principally for "binding". This term refers to the cohesiveness of the sausage. The meats with the best binding qualities are hot bull beef, fresh chilled bull beef, hot lean cow beef, and fresh chilled lean cow beef. Beef adds color and flavor and improves the texture of sausage by stabilizing the fat globules.

b. Pork - Pork contributes flavor, juiciness, and tenderness. Excessive quantities of pork produce a light color and may yield a fat cookout or separation and a reduced shelf life.

c. Ice Water, Salt, and Spices - The primary use of ice and water is to control temperature during chopping. It also aids in binding the product and provides a viscous emulsion to insure a smooth even flow during the stuffing operation. The ice water and salt combination solubilize proteins to help protect fat globules from rupturing during smoking and cooking. Salt alone acts as a curing agent and preservative. It inhibits bacterial growth and accentuates natural flavors. Sugar may be added as a flavoring agent; nitrites fix the color. Spices add flavor, color and aroma; some contain antiobiotics, others antioxidants.

3. Sausage Processing - Sausage processing includes grinding, processing in a silent cutter, vacuumizing, stuffing, and smoking and cooking.

a. Grinding Meat Components - Each step of sausage processing is important in producing an item which is acceptable to the military services. After the meat components are inspected and accepted, the inspector checks the sanitary condition of the equipment before it is assembled. In checking the grinder for sanitation, he begins with the hopper, which is the large bowl where the meat is fed into the grinder. Next, he checks the barrel of the grinder; this is where the large pieces of meat are reduced in size by the worm gear which forces the meat against the ribs of the barrel and carries it past the knife and through the plate. The knife and plate must be clean, sharp, and matched. "Matched" means that the same knife and plate are always used together. After grinding about 1,000 pounds of meat, the knife and plate are taken apart, and any bone, bone chips, gristle, or other material that will not go through the plates are removed. Since pork is more tender than beef and contains a large amount of fat, it is ground only once; this eliminates the possibility of overheating. Beef, however, is usually ground twice: first through a coarse plate, and then through a fine plate. The next step in processing sausage is to weigh the ground meat components separately.

b. Processing with Silent Cutter - After weighing, the ground meat is transferred to the silent cutter. The bowl of this cutter, which holds about 500 pounds of meat, rotates counterclockwise and carries the meat

to a set of three to nine knives. These knives are designed to fit the contour of the bowl and to cut through the meat at right angles to the bowl. The processing of meat in the silent cutter consists of chopping the beef several minutes while adding ice and water to control the temperature. This phase of processing produces a smooth, viscous mass (emulsion) which contains such soluble proteins of beef as myosin and collagen. Pork is then added to the silent cutter, and it is chopped and mixed with the beef. The spices and the remaining ice and water are added to the emulsion as the chopping continues. The chopping of pork produces tiny fat globules, which are very unstable when they are subjected to heat unless they are protected. These globules are protected by a covering of solubilized proteins which are spread throughout the emulsion. If the emulsion is chopped excessively, the fat globules decrease in size and increase in number; this results in an insufficient amount of protein to coat the individual fat globules. When this occurs, the uncoated fat globules will separate from the meat emulsion and settle in spaces between the casing and the meat or in the end of the sausage during smoking. This results in a condition called "fat caps".

c. Vacuumizing - Vacuumizing is done to extract any excessive air that has resulted from chopping in the silent cutter. It may be done in a vacuum chamber or in a vacuum-mixer combination. All sausages are not vacuumized.

d. Stuffing - The stuffer is a piece of equipment used in stuffing sausages into casings. It is a large, vertical cylinder with a piston. Near the top of the stuffer are one or more outlet valves. When these valves are open, the sausage emulsion is forced through the stuffing horn into the casing.

e. Smoking and Cooking - This is the last step in sausage processing. The sausage is placed in the smokehouse and heat is applied. The myosin coagulates and coats and stabilizes the fat particles. Collagen, another protein, also stabilizes fat unless heat is applied too quickly or if heat continues too long, or if the smokehouse temperature is excessive. Under any of these conditions, the collagen will convert to gelatin and drain away from the fat particles. This causes the fat to separate from the meat emulsion and to settle into internal pockets, or causes "fat caps" at the end of the sausage. Both collagen and myosin are capable of absorbing a considerable amount of water, but if the heat in the smokehouse or the cooker is continued too long, the protein coating will shrink and the fat globules will expand and squeeze out the water. With continued heating, the protein sac ruptures and the fat separates from the meat emulsion. Generally, frankfurters should be smoked for 1 1/2 to 2 1/2 hours. Larger sausages such as bologna require from 6 to 8 hours smoking time. An internal temperature for either large or small sausage should reach 148° to 150°F before processing is completed. Complete processing, smoking, cooking, and chilling by a cold water shower can be accomplished in air-conditioned smokehouses. Cooking time for small sausages is usually

10 to 15 minutes; for larger sausages, cooking time is from 1 to 2 hours. After cooking, sausages must be properly chilled and adequately refrigerated to obtain maximum storage life. The average shrinkage of sausage during smoking and cooking is 6 to 8 percent. This varies according to the quality of the raw material and the processing techniques that are used.

f. Defects in Sausage - Table 8-7 summarizes defects and their causes in sausage.

4. Inspection of Sausage - Four important items to check in sausage inspection are sanitary inspection of equipment, laboratory testing, raw material and workmanship, and the finished product.

a. Sanitary Inspection of Equipment - Sanitary inspection of plant practices, materials, and equipment is very important in the manufacture of sausage, mainly because any dirt or foreign material loses identity when it has been ground. Contaminated raw material may cause spoilage or discoloration of the finished product. You must insure that all equipment is cleaned with hot water or steam at the end of each day's operation. At least once a week, the equipment should be sanitized with a 4/10 percent solution of sodium hypochlorite or other sanitizer after it has been thoroughly cleaned with hot water or steam.

b. Laboratory Tests - Specifications generally require a laboratory test for pork sausage, frankfurters, and bologna.

(1) Pork Sausage - With pork sausage, the main concern is the amount of fat it contains. Contracts generally do not allow more than 40 percent fat; however, one day's production may contain as much as 42 percent fat, if the fat average for the total contract does not exceed 40 percent. When the laboratory report is received the reported percentage of fat is multiplied by the total pounds processed in that given lot to get the number of pounds of fat in the lot. This is done for each lot, and the total pounds of fat are determined. This total is then divided by the total weight of the sausage produced. The result is multiplied by 100 to obtain the total percentage of fat for the entire contract.

(2) Frankfurters - Frankfurters destined for overseas shipment are laboratory-tested for moisture and fat content. The maximum moisture content should not exceed 10 percent, and the fat content should not be less than 24 percent, not more than 30 percent. Frankfurters for domestic consumption are tested only for moisture.

(3) Bologna - Bologna is laboratory-tested for moisture.

c. Inspection of Raw Material and Workmanship - The meat components of all sausage must be fresh, properly refrigerated, adequately trimmed, and in the proper proportions. The inspector must begin his inspection

in the boning room. This includes inspecting the equipment and personnel. He must make certain that all cuts are offered for inspection as they exist in the carcass. Follow-through inspection must be made of each step in the processing including boning, grinding, chipping, stuffing, smoking, cooking, chilling, and packaging. Special attention must be directed to the contract to insure that raw materials meet the specifications, that no prohibited meat by-products such as salivary glands are used, and that excessive cereal fillers are not used.

d. Inspection of Finished Product -

(1) External Examination - Sausage is examined from the exterior first. An inspector looks for "touchers": two sausages which have touched each other, leaving an area where smoke has not penetrated. Sausages are observed for a uniform smoked color. This includes checking for oversmoking and undersmoking. The inspector checks for green discolorations from inadequate drying, sliminess from poor drying or poor handling in storage, improper or ruptured casings, air pockets, jelly pockets, and water pockets. All of these conditions are causes for rejection.

(2) Internal Examination - An inspector always uses a sharp knife when he examines a sausage internally in order to keep from tearing and smearing fat over the entire cut surface. He observes the uniformity of fat and lean meat and carefully notes the odor and taste. Conditions which may justify rejection include green centers, fat pockets, air pockets, jelly or water pockets, and the settling of fat at the end of the sausage.

SECTION M - INSPECTION AND PROCESSING OF EDIBLE ORGANS

1. General - This group specialty meat items derived from food-producing animals is also known in the trade as fancy meat, edible offal, and edible by-products. The group contains edible organs, viscera, and those fleshy portions of the carcass that can be specially processed for consumption without further preparation. As a result of medical research and educational campaigns, the items in this group have gained public acceptance and have become an important factor in the economics of livestock marketing; as an example, the yield of beef liver is about 2 percent of the weight of the dressed beef carcass, and the difference between profit and loss may depend on its proper salvage.

2. Livers - Liver is the main specialty meat procured for the Armed Forces; its purchase is limited to Class I, Beef, and Class IV, Pork. Liver in Class II, Calf, and Class III, Lamb, is procured in small quantities for resale purposes; Class V, Mutton, livers are not procured. Livers that are not marketed for consumption are used to make sausage, meat pastes and spreads, and animal food.

a. Identification of Livers - Livers may be identified with the food

animals from which they are derived by their conformation and size.

(1) Class I = Beef - The liver is composed of one main lobe and one small secondary (caudate) lobe. Steer and heifer livers are short, thick, and plump, while livers of mature cows tend to be elongated and thin. The military procurement of livers is limited to livers in the 4 to 16 pound weight range.

(2) Class II = Calf - The conformation of this organ is the same as that of beef liver. The only difference is that it is smaller.

(3) Class III = Lamb - These livers resemble calf livers to some extent. A deep fissure divides this liver into two distinct main lobes. The lower lobe has a decided twist to the side.

(4) Class IV = Pork - This organ is thick in the center and tapers to a thin edge. It consists of four distinct lobes which radiate in a fan-shaped manner from the center.

(5) Class V = Mutton - Mutton liver has the same conformation as lamb.

b. Color - There are wide variations in the colors of livers. Unless the colors are yellow or very dark, color is not a significant factor in determining unacceptability.

c. Trim - Livers are trimmed free of the gallbladder, external attachments, ragged edges, and superficial appendages. The large blood vessel (posterior ven cava) on the left border, and ducts and blood vessels lying along the concave (visceral) surface are trimmed even with the surrounding surface.

d. Scores and Blemishes - Slight scores and cuts are permitted if they do not interfere with the production of satisfactory slices. Scores and cuts parallel with the short axis of the liver are of less significance than those parallel with the long axis in determining acceptability, if they are within the tolerance requirements specified for the type (A or B) that is being procured. Post-mortem examinations by USDA inspectors include observing the incision of the large bile duct; "the incision should extend at least an inch through the bile duct dorsally and in the other direction as far as possible." Therefore, even though such cuts penetrate into liver tissue, they should be disregarded in determining type. "Water marking", is clearly defined dull or faded area on the surface of the liver caused by the flow of fluids which have dripped from adjacent livers, is not a defect.

e. Condition - Undesirable condition refers to those physical characteristics for pathological changes which are cause for non-acceptance. Except for defects of color, most undesirable livers are detected during Government inspection on the killing floor.

(1) Very Dark Brown Color - This color, usually associated with advanced age, indicates undesirable eating quality.

(2) Yellow Color - Livers of this color occasionally are found in well-fed steer; however, they usually result from advanced pregnancy and physiological disturbances. They are friable and easily broken under pressure and will not withstand normal handling in processing.

(3) "Sawdust" Livers - This condition is characterized by the presence of small, circumscribed, black or straw-colored specks, approximately 1/4 inch in diameter, which are on the surface of the liver beneath the capsule and which frequently extend into the liver tissue.

(4) Telangiectasis - This condition is characterized by purplish-black spots underneath the capsule, and contracted, reddish spongy areas in the tissue beneath.

(5) Abscess - This condition is caused by pathogenic and pus-producing bacteria carried to the liver by the blood or migrating parasites.

(6) Parasitism - Adult parasites which are normal inhabitants of the intestinal tract may migrate to the liver via the bile duct. During their life cycles, many species of parasites migrate through the liver tissue and leave tracts or areas of fibrous connective tissue.

(7) Bile Stain - This condition is characterized by diffuse areas of greenish discoloration on the surface of the liver capsule. It is caused by the rupture of the gallbladder during slaughter or trimming.

(8) Mutilations - These are excessive deep cuts and tears caused by faulty workmanship while the carcass is being removed. Regulations Governing the Meat Inspection of the USDA contain criteria for the disposition of abnormal livers. All livers branded with the USDA inspection legend are considered wholesome and fit for human consumption. However, if a liver is offered to military personnel for inspection and detailed examination reveals that it has an abnormality; it is provisionally rejected for further examination by the USDA inspector. Military inspection personnel can palpate each liver to determine its interior quality (the size and consistency of the bile ducts and the texture of the tissue) but they should never incise the liver; this is the responsibility of USDA inspection personnel.

f. Types - Livers are classified as Types A and B on the basis of the extent to which they are blemished, cut or scored.

(1) Type A - This liver is practically free of blemishes and

has cuts or scores that do not exceed 1 inch in any direction, or that have small sections removed and excluded, if such defects do not interfere with the making of intact and satisfactory slices.

(2) Type B - These livers have scores or surface cuts that do not exceed 2 inches in any direction; and have defects which do not interfere with the making of intact and satisfactory slices.

(3) Terms -

(a) Cut - A deep, lineal, penetration of the liver tissue on one of its surfaces.

(b) Score - A shallow, circumscribed area of penetration of the liver tissue on one of its surfaces.

(c) Excluded Portion - A part of the liver which has been removed, either accidentally or intentionally, and excluded. The missing portion usually involves a border of the liver rather than a surface; in this case, it should be considered a score. Estimation of the quantity of that portion which has been removed should be based on volume (weight).

g. Grades - Livers are classified into two grades according to conformation, texture, and uniformity of color. Grade 1 liver should be very short, compact, thick, and plump. It has very fine, smooth, firm, and resilient texture and a very attractive sheen with a bright uniform color. Grade 2 livers have the same characteristics as grade 1 livers, but to a moderate degree. The color may be slightly shaded or two-toned.

h. States of Refrigeration - After trimming, the livers are washed and drained in a chill room. Beef and calf livers are hung on hooks and drained on racks. Livers of other species may be hung on racks, or they may be drained on perforated trays.

(1) A, Chilled - Livers are thoroughly chilled promptly after they are removed from the carcasses and are maintained at temperatures that do not exceed 40°F until they are delivered or frozen.

(2) B, Frozen - Livers to be frozen must be selected, prepared, and handled under the direct supervision of Government agents. They are expeditiously packaged, packed, and frozen in a blast freezer or wind tunnel at 0°F, or lower, and held in storage at temperatures that do not exceed 6°F until they are delivered.

(3) C, Frozen, En Masse - Livers in this category are commercially selected and prepared in accordance with good commercial practice. They are not procured for military use.

i. Packaging - The product must be completely wrapped in cellophane wet-strength paper, parchment paper, waxed paper, or polyethylene film.

Beef livers are individually wrapped. One or more livers from other species may be enclosed in a single wrapper if their total weight does not exceed 12 pounds. Where practicable or necessary, a twist of wire, or a suitable metal clip should be used to secure the wrapper. Unless otherwise specified in the contractual document, beef and calf livers to be frozen for Navy use are separately wrapped or bagged before they are frozen. Products for domestic shipment are packaged in the same manner as products for domestic shipment (storage) and for overseas shipment, except that the physical requirements of the materials are not applicable. Current contractual documents specify that beef livers for overseas shipment will be individually packaged in polyethylene bags.

j. Packing - The product must be packed in a solid fiberboard box, a nailed wooden box, or a wirebound box. For domestic shipment (immediate use), the product is packed in any one of the types of containers cited above which is acceptable by common carrier or other carriers. For domestic shipment (storage) and for shipment overseas, the product will be packed in any one of the types of containers cited above, if it complies with the requirements of MIL-STD-129 and the applicable box specification. All boxes should be lined by hotwaxing the inner surfaces or by protecting them with wet, waxed paper, as applicable. Current contractual documents specify that beef livers for overseas shipment be packed 25 pounds per box, but they may be packed up to 35 pounds per box if there is no bulging.

k. Inspection Procedure - The sequence may vary between establishments, but the best way to insure that you accept only products which conform with the requirements is to follow the basic steps in this procedure. This procedure is based on procurement of frozen liver because this is the liver that the armed forces buy mostly; some small volumes of chilled livers are bought for local use, and the procedure, with minor changes, can be adapted for inspecting this item.

(1) External Examination - Identify the class of liver and by preliminary visual observation, estimate if the livers are within the specified weight range. Those which are estimated to be grossly overweight or underweight may be segregated for weighing. Examine the liver visually to determine if, the USDA legend is present, the color meets specified limits, trimming is accomplished, and the type and class is as specified. Palpation of the liver will indicate its condition.

(2) Temperature - Obtain the internal temperatures of several randomly selected livers. There is no specification requirement for maximum internal temperature; however, if the livers are placed in a chill room at 40°F or less promptly after they have been removed from the carcasses, and are held long enough to produce a well-drained item, the internal temperature should have become adjusted to that of the chill room. Internal temperatures above 40°F may be indicative of mishandling or inadequate refrigeration, and should alert the inspector to the possibility that off-condition livers are present.

3. Tongues, Beef: Fresh, Cured, or Smoked - Only beef tongues are marketed as fresh tongue. Tongues from other species of food animals are either canned whole or used as an ingredient in canned meat or sausage.

a. Color - These tongues should have a bright and uniform color (slight two-toning is permissible in cured tongues). Natural pigmentation, such as dark tips or dark outer membranes is acceptable.

b. Trim - These tongues should be of a standard, commercial, short cut trim. The tongue root should be removed at the base by a cut made close to and directly behind the hyoid (u-shaped) bones. A portion of the hinge bones and all of the gullet, soft palate, and rings of the trachea should be removed. The hyoid bones, cartilages, the epiglotis, and part of the hinge bones may remain. All frayed edges, semi-loose pieces of flesh, and fat thicker than 1 inch should be removed and excluded. These tongues should be free from discoloration, mucous, extraneous matter, freezer burn, and foreign odor.

c. Condition - Tongues are removed from the jaw or on the killing floor, and are inspected along with the head. Tongues showing embedded foreign bodies, sores, ulcers, abscesses, or contamination are trimmed or condemned at this time. All tongues properly branded with the USDA inspection legend are considered wholesome.

d. Grades - The product is graded in accordance with conformation, texture and color of the flesh, and the number of cuts and scores.

(1) Grade 1 - Grade 1 products are relatively short, thick, uniformly full, plump, and symmetrical. They have a fine smooth texture, and are firm and resilient. The membranous coverings are thick, smooth, and pliable. They should be practically free from blemishes which do not exceed two slight cuts or scores confined to the long or tip end and which do not interfere with the making of satisfactory slices. The color of the flesh is bright and fairly uniform.

(2) Grade 2 - Grade products have the same general characteristics as grade 1 products but to a moderate or fair degree. They will be fairly free from blemishes other than a few slight cuts, scores, or cut-off tip ends.

e. States of Refrigeration - Fresh, uncured tongues are placed under refrigeration promptly after they have been removed from the head and trimmed.

(1) Chilled - The following temperature ranges of storage facilities are applicable to the class of tongues that is being inspected. These temperature ranges apply to the storage facilities for the item; however, in the production of smoked tongues the temperatures cited can be applied to the storage facilities being used during a specific phase

of processing.

(a) Fresh - 28°F - 40°F

(b) Cured - 25°F - 40°F

(c) Smoked - 28°F - 55°F

(2) Frozen - Properly chilled products are promptly and thoroughly frozen to an internal temperature that does not exceed 10°F and stored at a temperature that does not exceed 6°F until shipment. Frozen tongues will not be stored for more than 60 days and will be kept thoroughly frozen until they are delivered.

f. Inspection Procedure - The procedure for the inspection of tongues varies in accordance with the class (fresh or smoked) and state of refrigeration specified in the purchase order or contract. The inspection of the two classes procured by the armed forces begins with the fresh product and, when procuring smoked tongues, continues through all phases of curing and smoking.

(1) External Examination - Visually examine each tongue and palpate it to determine if any pigmentation is present. The USDA legend, the grade, and condition are essential to the inspection.

(2) Temperature - Obtain the internal temperatures of several randomly selected fresh tongues. There is no specification requirement for maximum internal temperature of the fresh chilled product; however, if the tongues are placed in a chill room promptly after they have been removed from the head, and are held long enough to produce an item which is "reasonably dry and free from condensation", the internal temperature should have become adjusted to that of the chill room (28°-40°F). Fresh tongues to be delivered in a chilled state should be packaged, packed, and maintained at a temperature of from 28° to 40°F until the time of delivery. Tongues to be smoked need not be subjected to preliminary chilling to temperatures below 40°F, but they may be trimmed and pumped in a straightline operation soon after they have been removed from the head. In such instances, the pumped tongues will be promptly placed in curing solutions in chill rooms at a temperature of 25° to 40°F.

4. Hearts, Beef - Only hearts of beef are marketed as fresh heart. Hearts from other species of food animals are used as a component of sausages and canned meat items. Commercially, hearts are marketed "cap-on" or "cap-off"; the cap consists of the auricles and attached fat and blood vessels.

a. Trim - The "cap" is removed and excluded, and all blood clots removed.

b. Condition - Hearts are inspected on the kill floor by USDA

personnel. The walls of the ventricles and the interventricular septum are incised in search of Cysticercus bovis, the cystic (immature) stage of the beef tapeworm. The incisions may be made through the external ventricular walls or the heart may be inverted and the incisions made on the internal surfaces. This examination is omitted during the inspection of calves which are less than 6 weeks old. Hearts which are passed by the USDA are branded with the inspection legend.

c. Inspection Procedure - Thoroughly study the purchase instrument and familiarize yourself with all of the referenced procurement documents. Examine each heart visually to determine that the USDA inspection legend is present and the conformation and trim are as specified. Insure the packing, marking, and closure of the shipping container are adequate. You will place an impression of the DOD stamp on each container.

5. Brains - The demand for brains is extremely limited, and they are not procured by the military services for issue purposes. Commercially, the item is marketed fresh or canned. There are no specifications for brains; however, those offered for inspection must be whole, firm, bright in color, and free from blood clots, bone chips, hair, and other contaminants.

6. Kidneys - Most fresh kidneys are from young cattle. Kidneys from other food animals may be used in sausages, meat spreads, and canned and manufactured items. Beef kidneys are removed when the carcasses are divided into wholesale cuts. Depending upon local consumer demand, the kidneys of veal, lamb, and mutton are not removed from the carcasses, but are included as part of the loin chops.

a. Identification - Kidneys can be identified with the food animals from which they were derived by their conformation. Beef and calf kidneys are oval and lobulated. Sheep and hog kidneys are bean-shaped and have smooth surfaces.

b. Condition - Kidneys must be strictly fresh, of good color (dark red in young cattle and pale in older animals), full, and plump. They must be free from blemishes, suet, and odor of urine.

7. Sweetbreads - Thymus glands from young cattle only are marketed; those from animals over 1 year old are small, tough and fibrous. The glands are at their greatest stage of development at the time of birth or shortly thereafter; at this stage they are pale in color, meaty, and tender. They are located between the lobes of the lung in the front of the thoracic cavity and extend forward in the neck along the trachea as far as the thyroid gland. The glands are paired and are joined at the base of the neck by an isthmus. The pancreas of cattle is sometimes sold as "stomach" sweetbreads. It is reddish-brown, unpaired, and thinner and tougher than the thymus.

8. Miscellaneous Specialty Meats - This discussion of miscellaneous specialty meats will be brief. They are mentioned to acquaint you with their existence and to complete the material on specialty meats.

a. Pig's Feet - These are sold as uncooked fresh or cooked pickled.

b. Chitterlings - These are the large intestines of hogs.

c. Tripe - This is prepared from the stomachs of cattle and hogs. These two types are derived from beef animals.

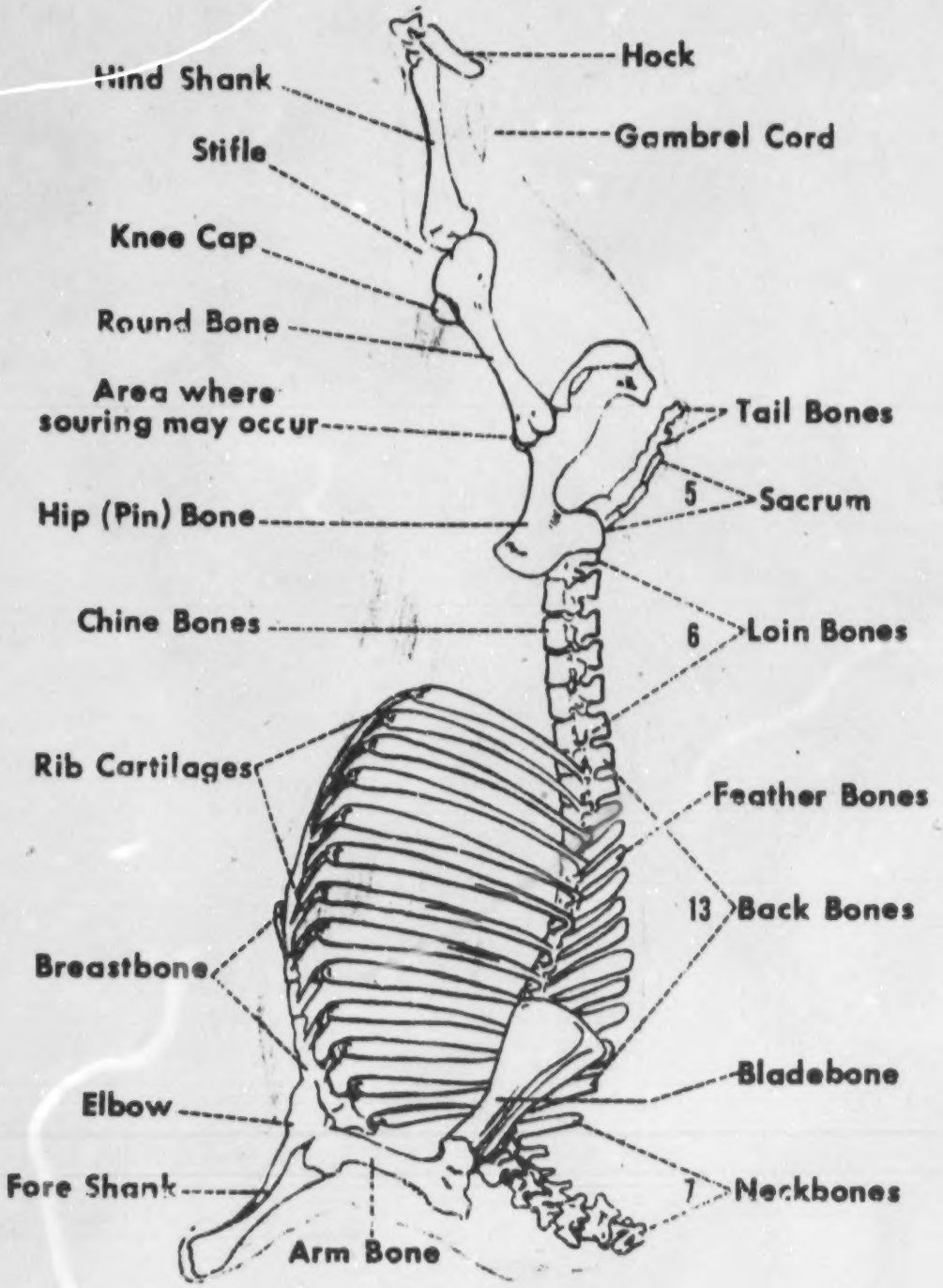
(1) Plain Tripe - Prepared from the paunch or rumen of the bovine.

(2) Honeycomb Tripe - Prepared from the reticulum.

d. Melts - These items are the spleens of cattle and are used primarily as a component of sausage and animal foods.

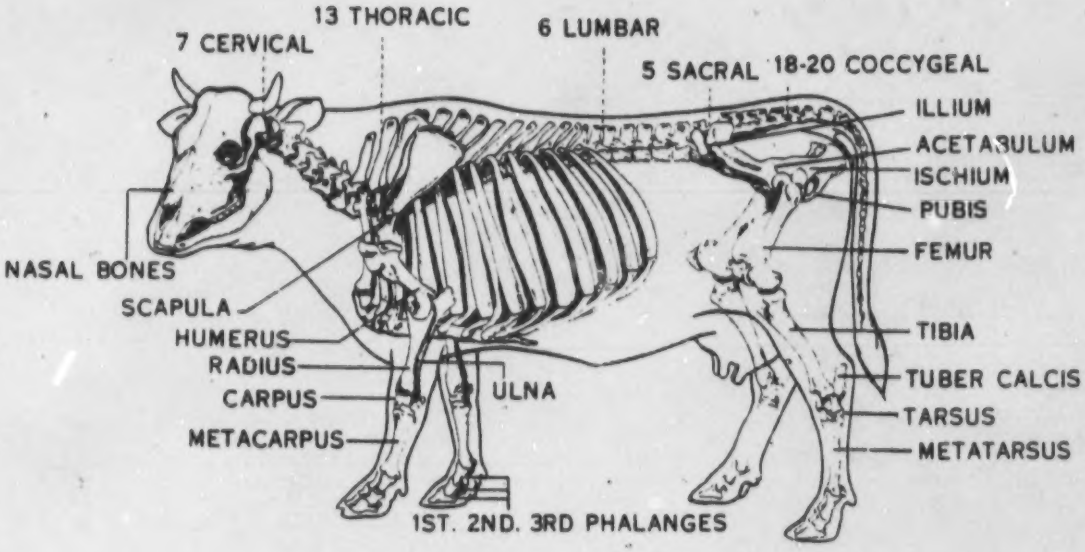
e. Fries - These items are the testicles of food animals; they are sometimes called mountain oysters.

f. Tidbits - These items are strips about 2 1/2 inches long and three-fourths of an inch wide cut from the shins of the hind-feet of hogs. They are cooked and pickled.

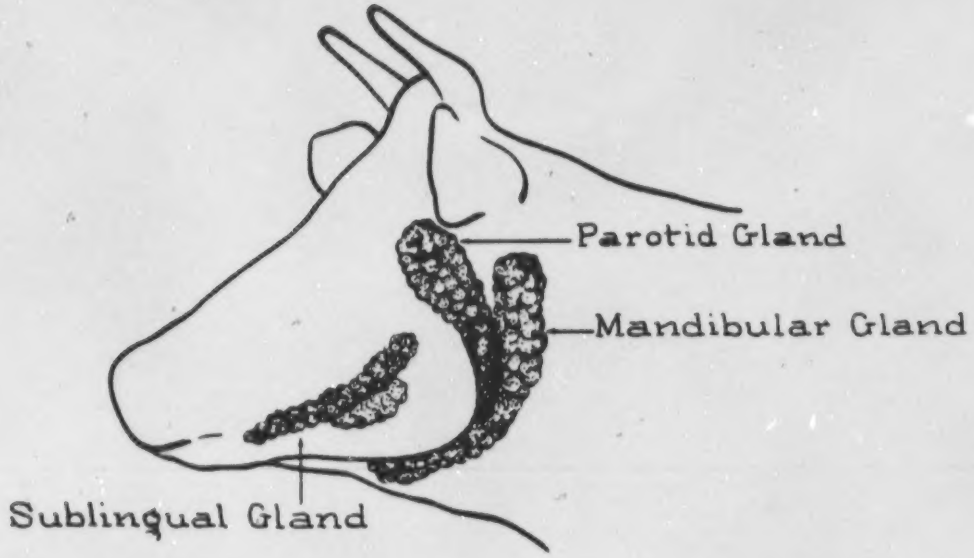


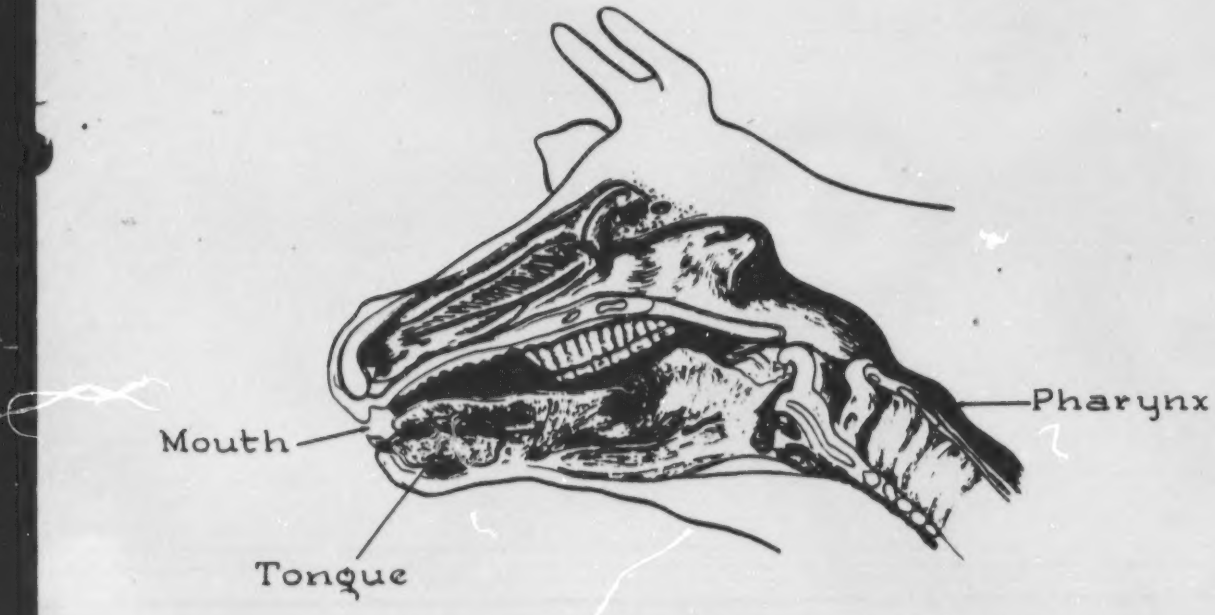
8-1 BEEF SKELETAL CHART

8-87

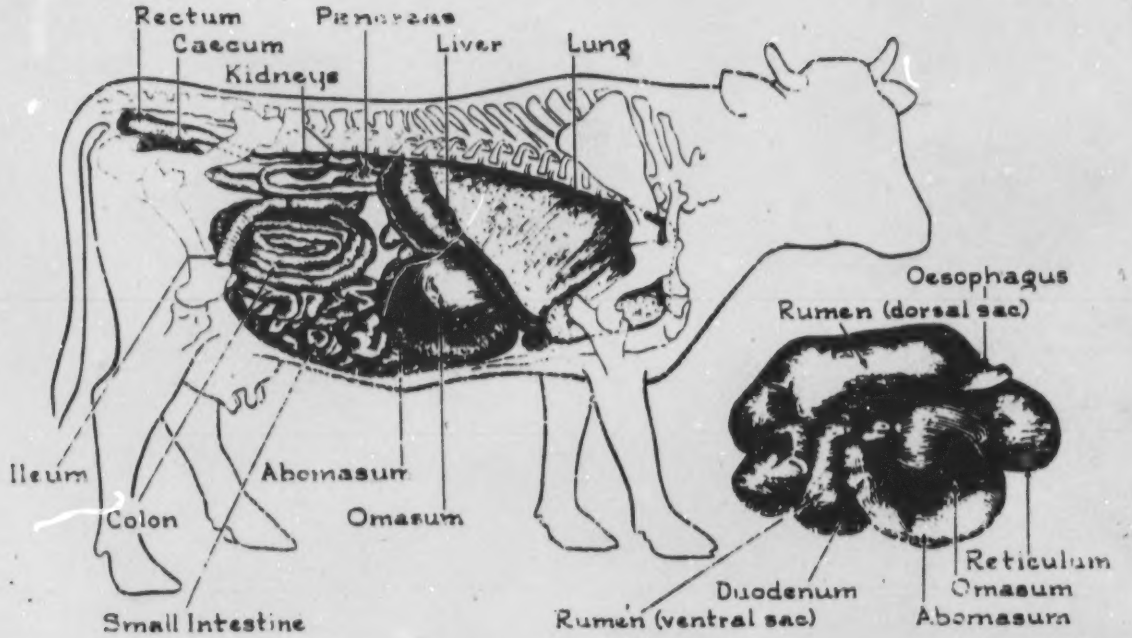


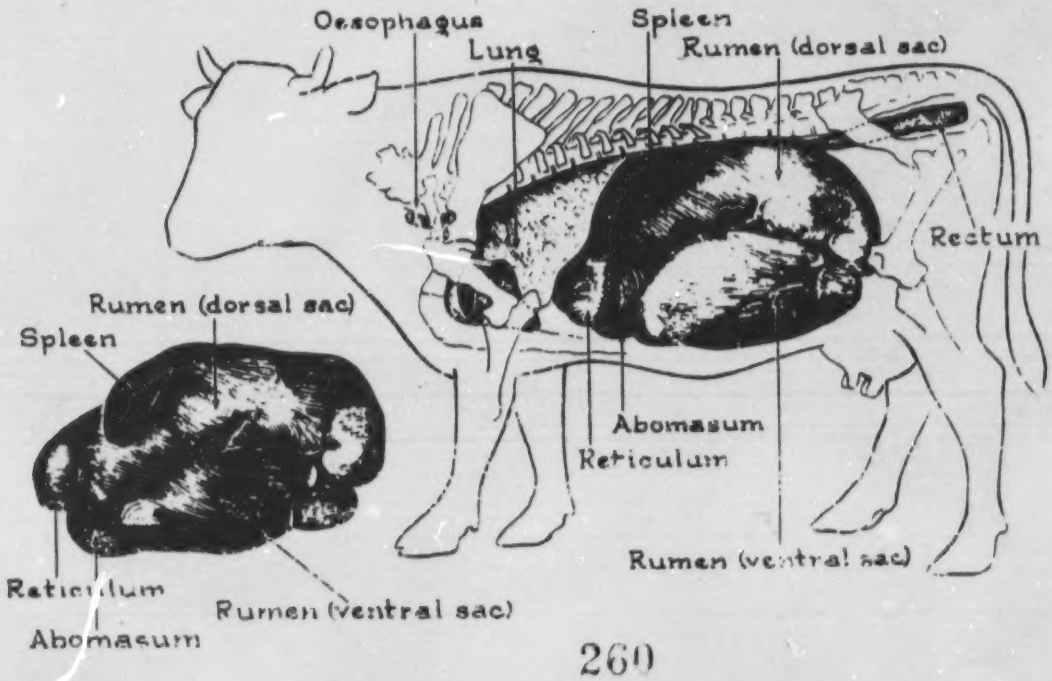
8-2 THE SKELETON OF THE BOVINE





8-3 DIGESTIVE SYSTEM OF THE BOVINE
(ACCESSORY ORGANS)





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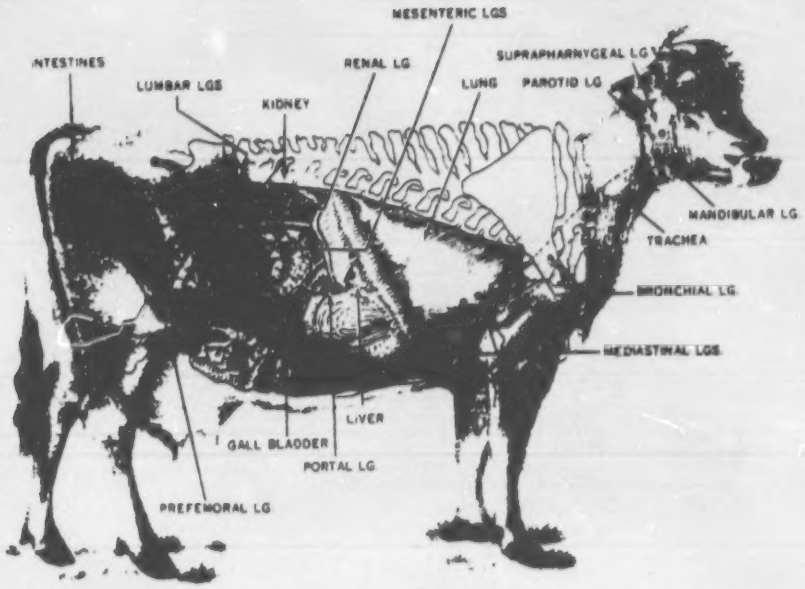
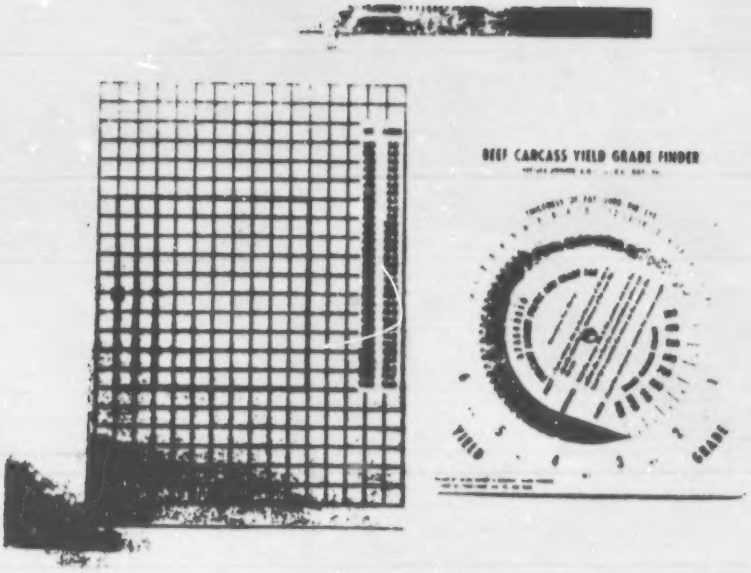
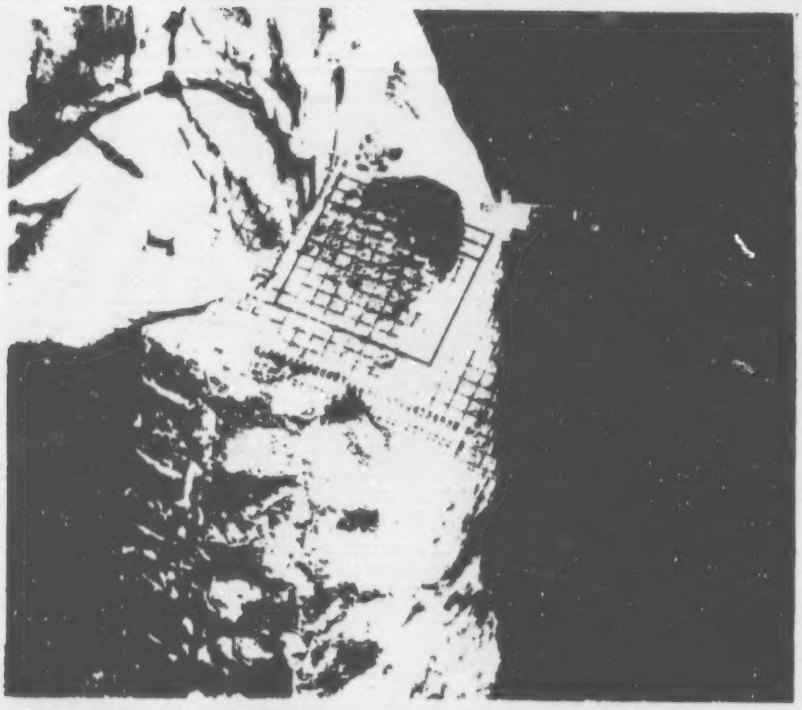
8-4 DIGESTIVE SYSTEM OF THE BOVINE



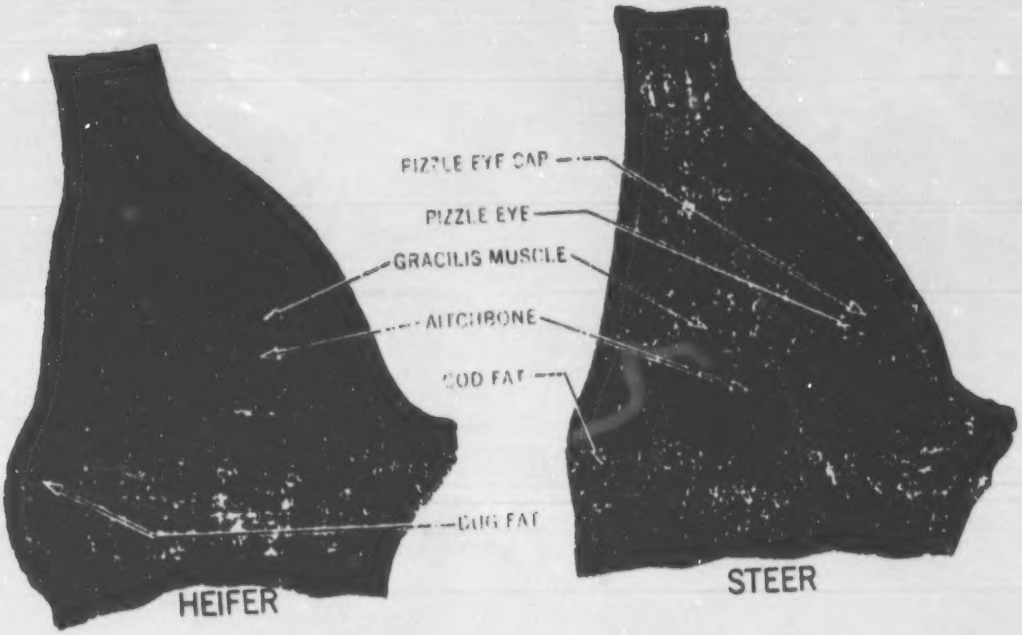
8-5 LOCATION OF LYMPH GLANDS



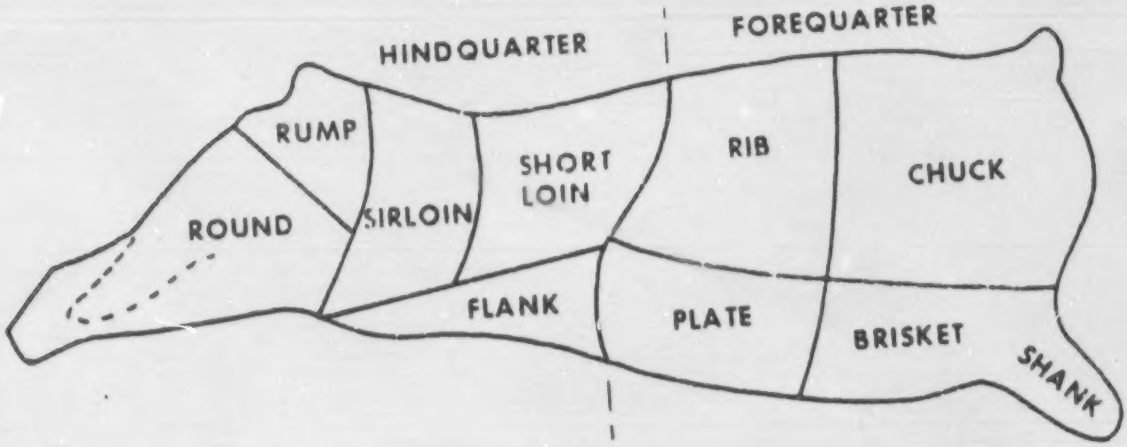
8-6 EQUIPMENT FOR CUTABILITY DETERMINATION



8-7 MEASURING FAT COVERING OVER RIB EYE WITH RULER AND MEASURING THE RIB EYE AREA WITH A GRID

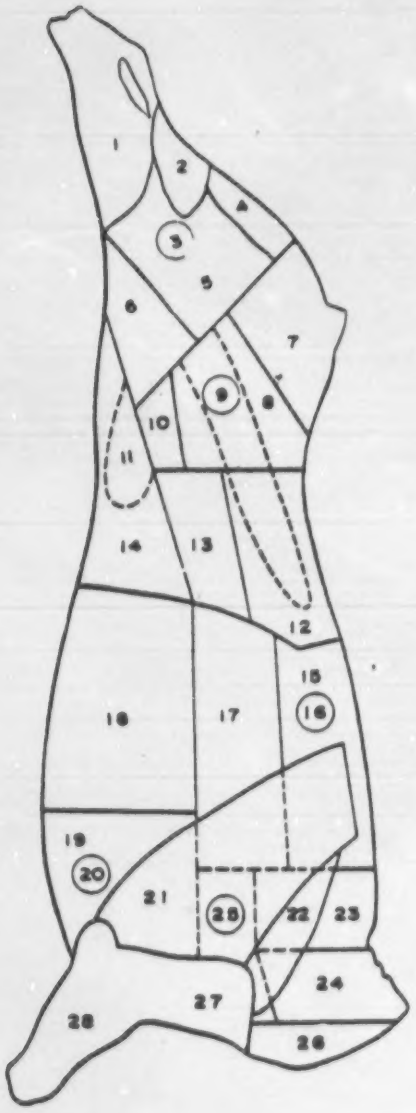


8-8 SEX FACTORS FOR BEEF



8-9 BEEF WHOLESALE CUTS

8-93



1. Hindshank Meat
2. Heel
3. Top Round (Inside)
4. Eye of Round
5. Bottom Round
6. Knuckle
7. Sirloin Rump
8. Top Sirloin Butt
9. Tenderloin
10. Bottom Sirloin Butt
11. Flank Steak
12. Loin Strip
13. Loin Wing
14. Flank Meat
15. Ribeye Cover
16. Ribeye
17. Rib Wing
18. Short Plate
19. Brisket
20. Deckle
21. Shoulder Clod
22. Chuck Tender
23. Chuck Roll BE
24. Chuck Roll NE
25. Inside Chuck
26. Neck Meat
27. Armbone Muscle
28. Foreshank Meat

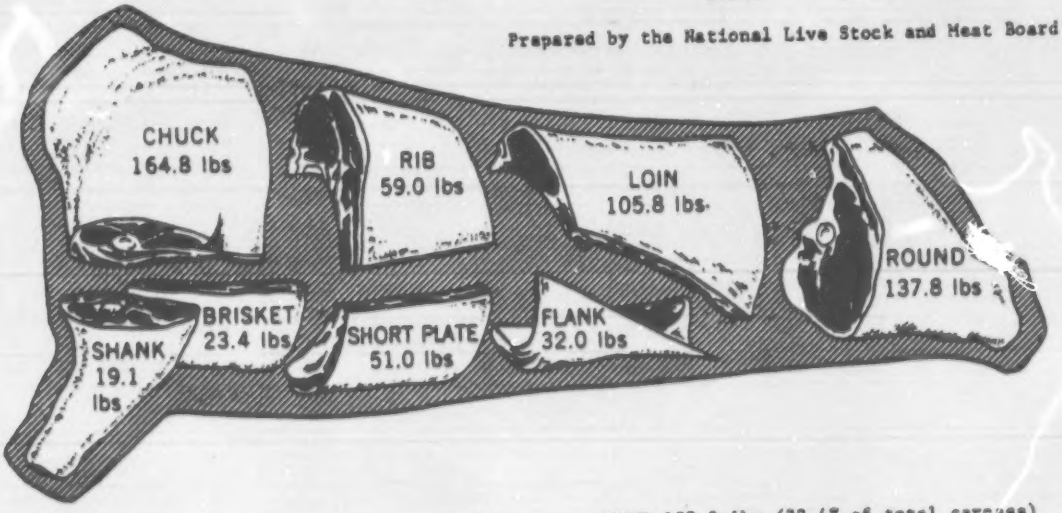
8-10 LOCATION OF BONELESS BEEF CUTS

A STEER'S NOT ALL STEAK...
an important factor in the price you pay for beef

	Saleable Beef-lbs	Other lbs
. CHUCK 164.8 lbs (26.8% of total carcass)		
Blade pot roasts	59.3	
Stew or ground beef	32.1	
Arm pot roast	22.3	
Cross rib pot roast	10.7	
Boston cut	9.9	
Fat and bone		30.5
TOTAL	134.3 lbs	30.5 lbs
. BRISKET 23.4 lbs (3.8% of total carcass)		
Boneless	9.4	
Fat and bone		14.0
	9.4 lbs	14.0 lbs
. SHANK 19.1 lbs (3.1% of total carcass)		

	Saleable Beef-lbs	Other lbs
. RIB 59.0 lbs (9.6% of total carcass)		
Standing rib roasts	24.2	
Rib steaks	12.4	
Short ribs	4.7	
Braising beef	2.7	
Ground beef	3.5	
Fat and bone		11.5
TOTAL	47.5 lbs	11.5 lbs
. LOIN 105.8 lbs (17.2% of total carcass)		
Porterhouse steak	18.7	
T-bone steak	9.5	
Club steak	5.2	
Sirloin steak	41.4	
Ground beef	2.9	
Fat bone		28.1
TOTAL	77.7 lbs	28.1 lbs

Prepared by the National Live Stock and Meat Board



. SHORT PLATE 51.0 lbs (8.3% of total carcass)		
Plate, stew, short ribs	40.8	
Fat and bone		10.2
TOTAL	40.8 lbs	10.2 lbs
. FLANK 32.0 lbs (5.2% of total carcass)		
Flank	3.2	
Ground Beef	12.6	
Fat		16.2
TOTAL	15.8 lbs	16.2 lbs
MISC. 22.1 lbs (3.6% of total carcass)		
Kidney, hanging tender	3.6	
Fat, suet, cutting losses		18.5
TOTAL	3.6 lbs	18.5 lbs

	Saleable Beef-lbs	Other lbs
. ROUND 137.8 lbs (22.4% of total carcass)		
Top round (inside)	21.0	
Bottom round (outside)	20.3	
Tip	13.1	
Stew	8.3	
Rump	4.8	
Kabobs or cubes	2.1	
Ground beef	14.2	
Fat and bone		54.0
TOTAL	83.8 lbs	54.0 lbs

SUMMARY
(1000 lb choice steer)

Dresses out 61.5%	615 lbs
Less fat, bone and loss	183 lbs
Saleable beef	432 lbs

8-94a

A steer's not a steak. The steak is easy enough to sell even at today's prices, but what about the pot-roasts and short ribs?

The retail seller (grocery stores or meat markets) must sell it all. So to get a housewife to buy that pot-roast, the market manager may price it below cost or its worth. To make up for the loss, he will mark the prices on those popular cuts a bit higher.

RETAIL PRICES for beef must cover the price paid the cowman for producing it, cost of processing, refrigeration, transportation, rent, taxes and labor. In the end, retail stores must price beef so they sell it all and not end up with only less-than-demand cuts.

A half-ton steer, on the average, yields 615 pounds of carcass. From an additional 183 pounds of fat, bones, and waste are cut when the carcass is processed into retail cuts...leaving only about 432 pounds of retail beef cuts, or less than half of the initial weight.

IF THAT 1,000-POUND steer cost 40 cents a pound, or $400 then the 432 pounds of beef---without all the above mentioned extras---should be worth 92 1/2 cents a pound.

There's no quick way to a T-bone steak. Nine months of a cow's room and board until the calf is born, six or seven months with cow and calf on pasture, plus 330 pounds of grain, 70 pounds of protein and 10,000 pounds of hay, silage and grass are needed to grow a calf to weaning weight or 500 pounds.

Then follows another four to six months in the commercial feedlot for consumption of roughly 20 pounds of feed per day. If on feed 150 days the animal will eat 3,000 pounds of grain.

SUPPLY AND DEMAND set the price of beef. But unlike most manufactured products, beef prices fluctuate up and down because supply and demand are constantly changing.

When housewives buy more beef, supplies are used up and prices tend to rise. Rising beef prices are automatic "signals" to farmers and ranchers to increase production until there's more beef at the neighborhood store.

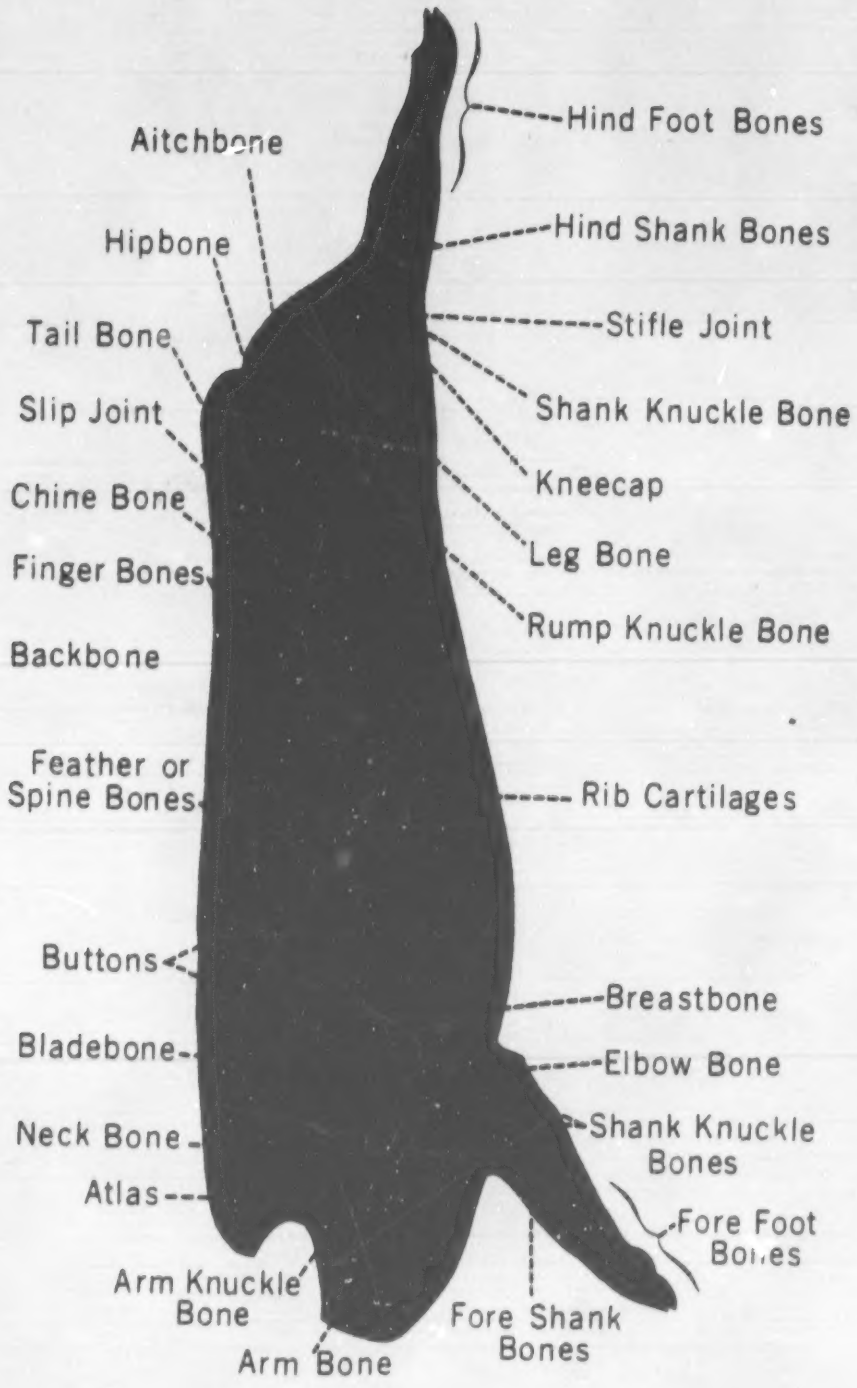
WHEN CONSUMERS BUY less, there's no way to stop the beef production line. Farmers-ranchers have to market cattle already on hand when they're ready regardless of price. So the supply continues even though demand falls off and beef prices drop.

SPOOL JOINT

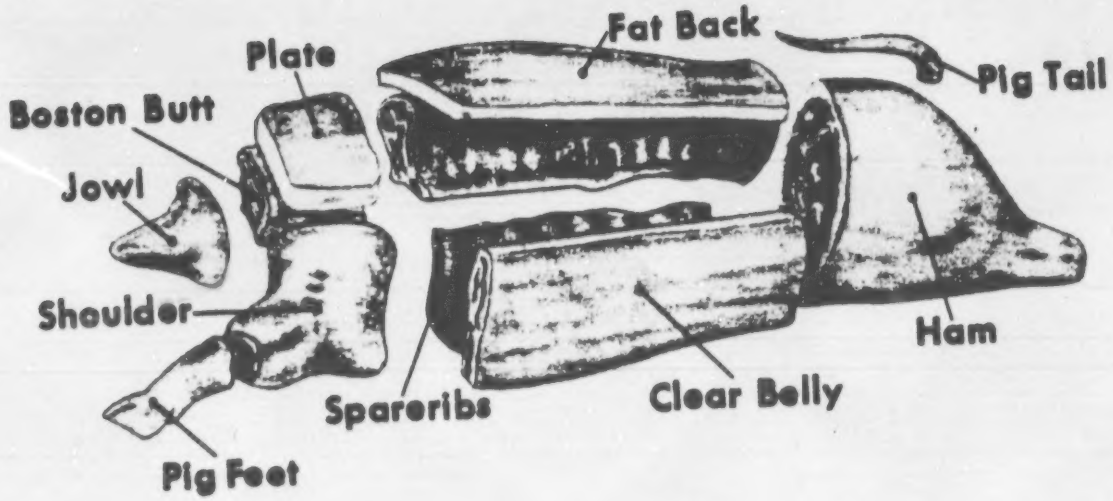
YEARLING JOINT

BREAK JOINT

8-11 DISTAL END OF AN OVINE FORESHANK AFTER SHANKING



8-12 SKELETON OF THE PORK CARCASS

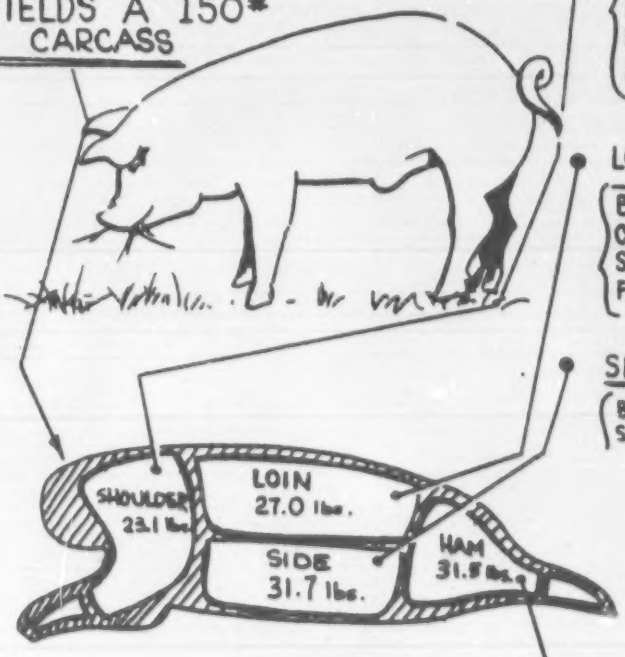


8-13 PORK WHOLESALE MARKET CUTS

Why a Hog's "NOT" all Chops.

A 210* LIVE HOG DRESSES OUT **71.5%** LOSES 60 lbs.

YIELDS A 150* CARCASS



SHOULDER 23.1 lb. (15.4% of TOTAL CARCASS.)

	SALEABLE PORK CUTS - lbs.	OTHER lbs.	
BOSTON SHOULDER	9.4		
FAT FOR LARD		.5	
PICNIC SHOULDER CUBES	7.0		
BONE		2.8	
HOCKS	3.4		
TOTAL	19.8 lb.	3.3 lb.	23.1 lb.

LOIN 27.0 lb (18.0% of TOTAL CARCASS.)

BLADE ROAST (5 RIB)	6.3		
CENTER CHOPS	13.3		
SIRLOIN ROAST	4.2		
FAT FOR LARD		3.2	
TOTAL	23.8 lb.	3.2 lb.	27.0 lb.

SIDE 31.7 lb (21.1% of TOTAL CARCASS.

BACON, CURED	24.0		
SAUSAGE TRIM.	2.0		
SPARERIBS	5.7		
TOTAL	31.7 lb.		31.7 lb.

HAM 31.5 lb (21.0% of TOTAL CARCASS.

ROLLED LEG OF PORK ROAST, BONELESS	19.8		
SAUSAGE TRIM.	2.8		
SKIN	2.2		
FAT FOR LARD		3.2	
BONE AND SHRINK		3.5	
TOTAL	24.8 lb.	6.7 lb.	31.5 lb.

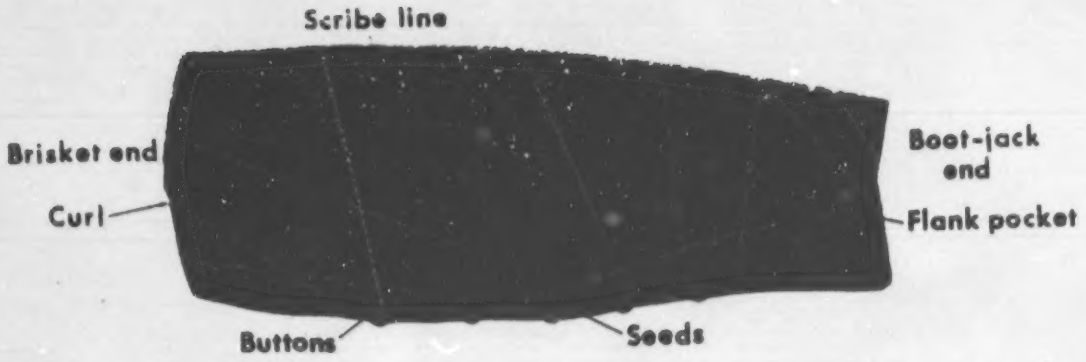
MISCELLANEOUS 36.7 lb (24.5% of TOTAL CARCASS.

JOWL, TRIMMED	4.5		
FEET, TAIL HECKBONE	9.0		
SAUSAGE TRIMMINGS	6.4		
FAT FOR LARD		16.8	
TOTAL	19.9 lb.	16.8 lb.	36.7 lb.

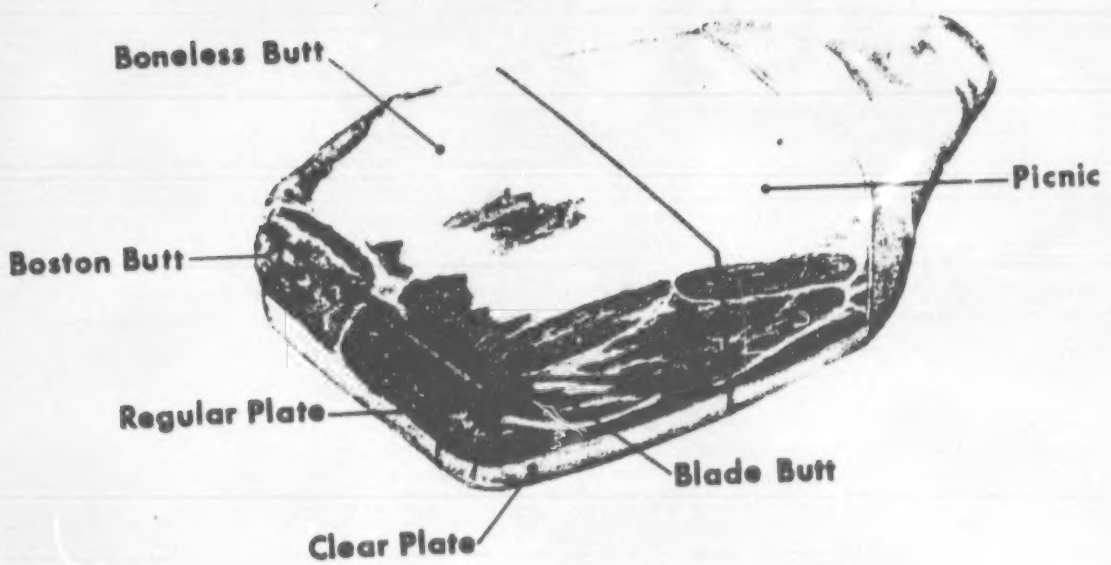
TOTAL SALEABLE PORK CUTS	120.0 lb.
TOTAL FAT FOR LARD	23.7 lb.
BACON AND SHRINK	6.3 lb.
TOTAL CARCASS WEIGHT	150.0 lb.

Prepared by:
NATIONAL LIVE STOCK AND MEAT BOARD

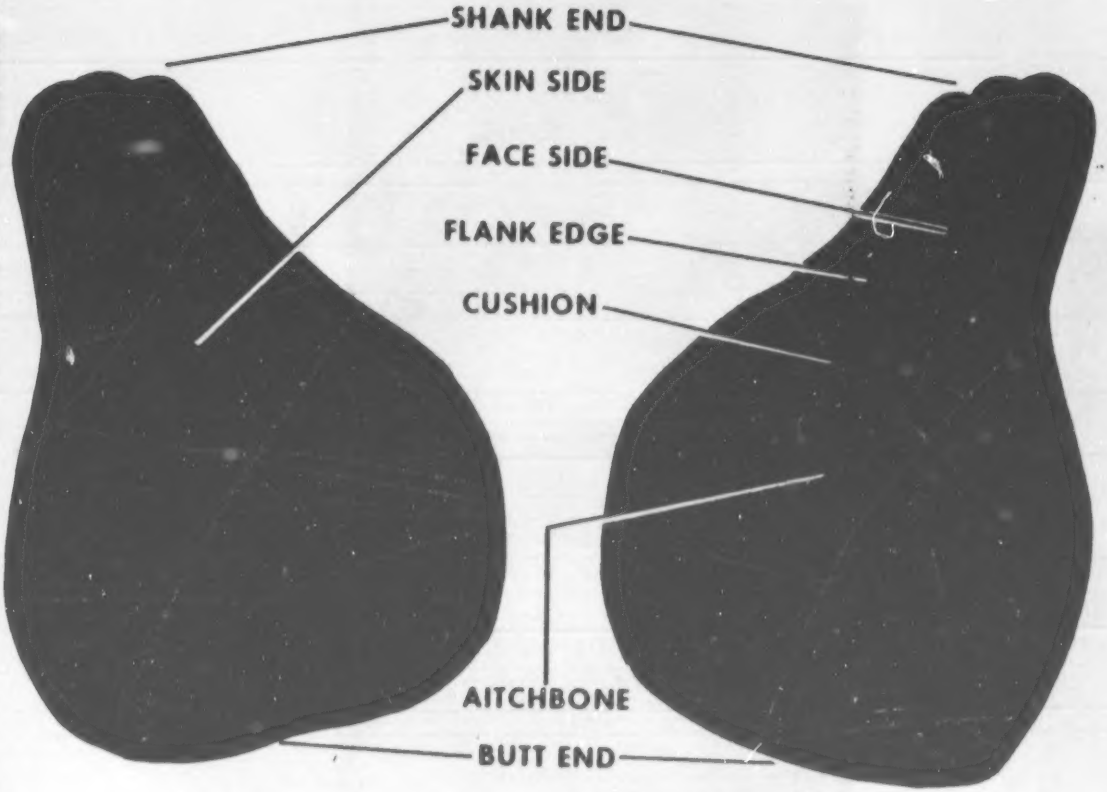
8-97a



8-14 PORK BELLY



8-15 PORK SHOULDER CUTS



8-16 PARTS OF THE HAM

SECTION O - Tables

8-1 BEEF PALATABILITY CHARACTERISTICS

Grade	Conformation	Quality					
		Chine Bone	Thoracic Vertebrae	Sacral Vertebrae	Lumbar Vertebrae	Rib Bones	Ribeye Muscle
Prime	Thickly muscled throughout. Wide and thick in relation to length. (Loins and ribs thick and full. Rounds plump, carrying well down to the hocks. Thick chucks. Necks and shanks tend to be short.)	Slightly red and soft.	Cartilagenous ends show evidence of ossifying (hardening) to partially ossified.	Completely fused.	Cartilagenous ends nearly completely ossified.	Slightly wide and slightly flat.	Light red in color, finely textured, and moderately firm. Minimum degree of marbling required increases with advancing maturity throughout this group from minimum slight abundant to maximum slight abundant.
Choice	Moderately thick muscled throughout. Moderately wide and thick in relation to length. (Loins and ribs moderately thick and full. Rounds and chucks moderately plump and moderately thick. Necks and shanks tend to be moderately short.)	Slightly red and slightly soft.	Cartilagenous ends show evidence of ossification to partially ossified.	Completely fused.	Cartilagenous ends nearly completely ossified.	Slightly wide and slightly flat.	Moderately light red in color, finely textured, and slightly firm. Minimum degrees of marbling required increases with advancing maturity throughout this group from a minimum modest amount to a maximum modest amount.
Good	Slightly thick muscled throughout. At least moderately symmetrical and uniform in contour. (Loins and ribs are slightly thick and full. Rounds tend to be slightly plump. Necks and shanks tend to be slightly long and thin.)	Slightly red and slightly soft.	Cartilagenous ends show evidence of ossification to moderately ossified.	Completely fused.	Cartilagenous ends nearly completely ossified.	Slightly wide and slightly flat.	Slightly light red in color, finely textured, and moderately soft to soft. Minimum degree of marbling required increases with advancing maturity throughout this group from typical traces to a typical slight amount.
Standard	Thinly muscled throughout. Slightly narrow and thin in relation to their length. At least moderately symmetrical and uniform in contour. (Loins and ribs tend to be flat and slightly thin fleshed. Rounds tend to be thin and slightly concave. Chucks tend to be flat and thin fleshed.	Slightly red and slightly soft.	Cartilagenous ends show evidence of ossification to moderate ossification.	Completely fused.	Cartilagenous ends nearly completely ossified.	Slightly wide and slightly flat.	Slightly dark red in color, finely textured, and soft to moderately soft. Minimum degree of marbling required increases with advancing maturity throughout this group from minimum practically devoid to maximum practically devoid.

8-1 (contd) BEEF PALATABILITY CHARACTERISTICS

Grade	Conformation	Ossification					
		Chine Bone	Thoracic Vertebrae	Sacral Vertebrae	Lumbar Vertebrae	Rib Bones	Ribeye Muscle
Commercial	Slightly thin muscled throughout. Because of usually moderately heavy fat covering, the carcasses tend to be slightly thick but rather rough and irregular in contour. (Rounds tend to be thin and slightly concave. Loins tend to be moderately wide but slightly sunken and hips are rather prominent. Ribs tend to be slightly thin and the plates and briskets are wide and "spready." Necks and shanks are slightly long and thin.)	From moderately hard to hard. From practically white to white in color.	Cartilagenous ends show considerable ossification. The outlines of the cartilages are from barely visible to visible	Completely fused.	Cartilagenous ends nearly completely ossified.	From moderately wide and flat to wide and flat.	From moderately dark red and slightly coarse in texture to dark red and coarse, and from slightly firm to firm. Minimum degree of marbling required increases with advancing maturity throughout this group from a minimum small amount to a maximum small amount.
Utility	Thinly muscled throughout. Very narrow in relation to length. Decidedly rangy and angular in contour. Usually thinly fleshed. (Loins and ribs are flat and thinly fleshed. Rounds tend to be very concave. Chucks are thin and flat. Necks and shanks are long and tapering. Hips and shoulder joints are prominent. Carcasses within the full range of maturity classified as beef are included in this grade.)	Slightly red and slightly soft, to hard and white.	Cartilagenous ends have some evidence of ossification. The outline of the cartilages are barely visible.	Completely fused.	Cartilagenous ends are nearly completely ossified.	Slightly flat to wide and flat.	Slightly dark red and fine in texture. Slightly firm to soft, to the touch, and may be slightly watery. Devoid to maximum small amount of marbling.
Cutter	Thinly muscled throughout. Rangy, angular, and irregular in contour. Very thinly fleshed. (Loins and ribs are very flat, thin and shallow. Necks and shanks are very long and tapering. Hips and shoulder joints are very prominent.) The range in maturity extends to include carcasses from the oldest animals produced for beef.	Slightly red and slightly soft to hard and white.	Cartilagenous ends have some evidence of ossification. The outline of the cartilages are barely visible.	Completely fused.	Cartilagenous ends nearly completely ossified.	Slightly wide and slightly flat, to wide and flat.	Slightly dark red and fine, to very dark red and coarse in texture. Devoid to practically devoid of marbling. Soft and watery, to very soft and watery.

Canner — Carcasses that are inferior in conformation and quality to the minimum requirements specified for Cutter Grade are graded Canner.

8-2 MARKET CLASSES AND GRADES FOR DRESSED BEEF

Group I	Grade	Groups II & III	Grade
Steer, heifer and cow*	Prime Choice Good Standard Commercial Utility Cutter Canner	Bull and Stag	Choice Good Commercial Utility Cutter Canner

(*Cow beef is not eligible for Prime Grade.)

8-3 CUTABILITY GRADE REQUIREMENTS

Cutability Group	External Fat	Fat Over Ribeye	Ribeye Size	*Internal Fat
1	Usually thin over ribs, loins, rumps, clods, and very thin over the outside of the rounds and the top of the shoulders and neck. Slight deposits are present in the flank and udder. Muscle may be visible through the fat in many areas.	A 500 pound carcass near the borderline of Cutability Groups 1 and 2 may have 3/10 inch. An 800 pound carcass may have 4/10 inch.	A 500 pound carcass near the borderline of Cutability Groups 1 and 2 may be 11.5 square inches. An 800 pound carcass may be 16.0 square inches.	Not over 2.5 percent of carcass weight.
2	Nearly completely covered. Lean is plainly visible through the fat over the outside of rounds, top of shoulders, and neck. That over the rumps, hips, and clods is usually slightly thick. Slight deposits are present in the flanks and udder.	A 500 pound carcass near the borderline of Cutability Groups 2 and 3 may have 5/10 inch. An 800 pound carcass may have 6/10 inch.	A 500 pound carcass near the borderline of Cutability Groups 2 and 3 may be 10.5 square inches. An 800 pound carcass may be 15.0 square inches.	Not over 3.5 percent of carcass weight.
3	Usually completely covered. Lean is usually visible through the fat only on the neck and lower part of outside round. Fat over loins, ribs, and inside rounds is usually slightly thick. That over the rumps, hips, and clod is moderately thick. Slightly large deposits are usually present in the flanks and udder.	A 500 pound carcass near the borderline of Cutability Groups 3 and 4 may have 7/10 inch. An 800 pound carcass may have 8/10 inch.	A 500 pound carcass near the borderline of Cutability Groups 3 and 4 may be 9.5 square inches. An 800 pound carcass may be 14.0 square inches.	500 pound carcass -- Not over 4.0 percent of carcass weight. 800 pound carcass-- Not over 4.5 percent of carcass weight.
4	Usually completely covered. Only muscles usually visible are those on the shank, and over outside of plates and flanks. Fat is usually moderately thick over loins, ribs, and inside round. That over the rump, hips, and clod is usually thicker. Large deposits are usually present in flanks and udder.	A 500 pound carcass near the borderline of Cutability Groups 4 and 5 may have 1 inch. An 800 pound carcass may have 1 1/10 inches.	A 500 pound carcass near the borderline of Cutability Groups 4 and 5 may be 9.0 square inches. An 800 pound carcass may be 13.5 square inches.	500 pound carcass -- Not over 4.5 percent of carcass weight. 800 pound carcass-- Not over 5.0 percent of carcass weight.
5	A carcass in cutability group 5 usually has more fat on all of the various parts, a smaller area of ribeye and more kidney, pelvic, and heart fat than a carcass in Cutability Group 4.			

*If product is first graded for palatability (quality) the percentage of allowable internal fat is based on that grade.

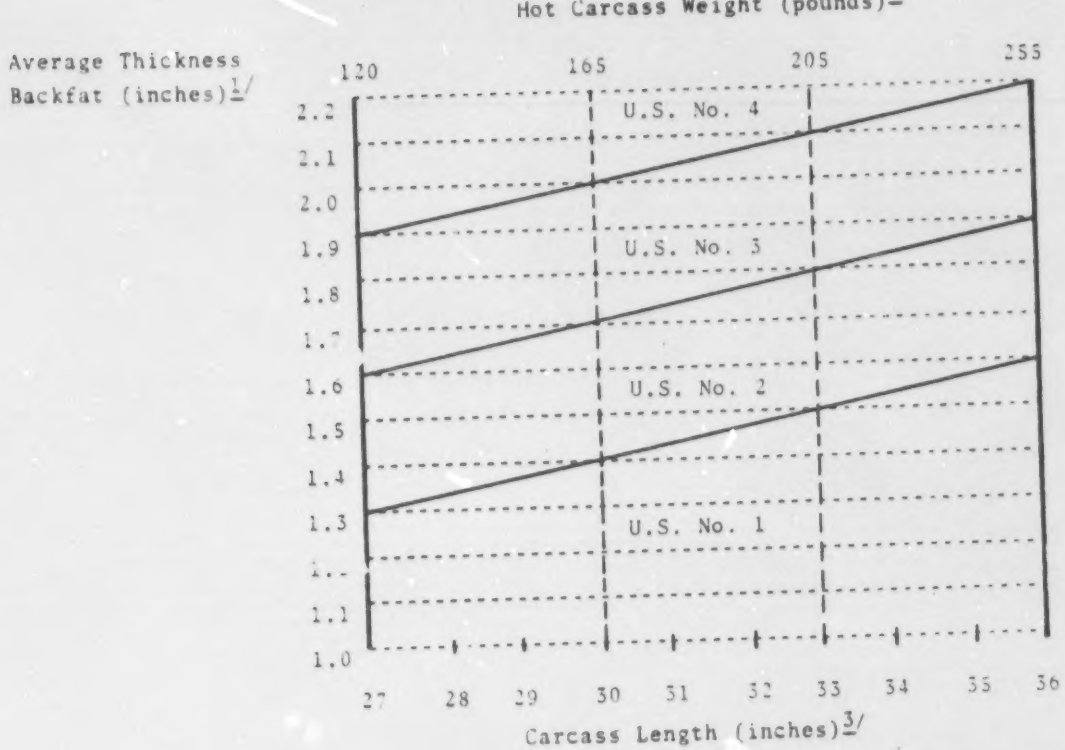
8-4 VEAL AND CALF GRADES AND GRADING FACTORS

Grade	Conformation	Finish	Quality
Prime	Broad, compact build tends to be thickly fleshed with a rather plump, well-rounded appearance. Rounds tend to be thick and bulging. Loin and back tend to be full and plump. Shoulders and breast tend to be thick.	A thin covering of firm fat over rump, loin, and back extending over the tops of the shoulders and the outsides of the legs. Modest fat streaking on inside of flank muscles, and modest fat covering over the diaphragm. Flanks are thick and firm. Kidney and pelvic fat is firm and moderately abundant.	Cut surface of lean is moderately firm, finely textured, greyish pink for veal or greyish red for calf. Texture is velvety to sight and touch.
Choice	Moderately blocky and compact, and broad in proportion to length. All parts are moderately thick fleshed; rounds are slightly bulged and thick.	A very thin covering for veal and a moderately thin covering for calf over back, loin, tops of shoulders and over the outsides of the legs. Moderate fat covering over the skirts and moderate fat streaking in the inside of flank musculature. Flanks are firm, full, and thick. Kidney and pelvic fat is firm and moderately abundant.	Moderately firm, finely textured, and light greyish red in calves, light greyish pink in veal carcasses.
Good	Slightly broad, compact, and blocky. Slightly thin fleshed with little or no evidence of plumpness. Loin, back, and rounds are slightly thin and nearly flat.	Extremely thin fat covering over back and loin, with practically no fat over tops of shoulders or outsides of legs. Only traces of fat streaking the flank and covering diaphragm. Small amount of kidney and pelvic fat.	Texture of lean is fine, but slightly soft and dark in color. Cut surface is rather moist to sight and touch.
Standard	Thinly fleshed, rangy, angular, and narrow in relation to its length. Rounds are thin, tapering, and slightly concave. Loin and back depressed. Shoulders and breast are thin.	External fat usually limited to very thin patches over the loin, back, and base of tail. Practically no fat streaking the inside flank muscles and over the diaphragm. Flanks are thin and soft. Only slight amounts of pelvic and kidney fat.	The cut surface of the lean is finely textured, but moderately soft, moist, and slightly dark. Greyish pink in color.

8-5 GRADES OF LAMB NORMALLY PROCURED BY THE DOD

Grade	Conformation	Ribs	Breakjoints	Flanks	External Finish
Prime	Compact, blocky with plump, full legs. Back wide and thick. Shoulders thick, smooth and full. Neck short and thick.	Red and narrow to slightly red and slightly narrow. Moderate to rather extensive feathering between the ribs. Small to moderate amount of overflow fat over the inside of the ribs adjacent to the backbones.	Red, moist, porous to rather dry and hard.	Inside flank muscle light pink to dark pink color, modest to slightly abundant quantity of fat streaking. Flanks full and firm to very full and firm.	Firm to very firm.
Choice	Slightly compact, with slightly plump full legs. Back slightly wide and thick. Shoulders slightly wide and full. Neck slightly short and thick.	Red and narrow to slightly red and slightly wide. Small to moderate amount of feathering between the ribs. Slight to small amount of overflow of fat over the inside of the ribs adjacent to the backbone.	Red, moist, porous to rather dry and hard.	Inside flank muscle slightly dark pink to dark pink in color, slight to small amount of fat streaking. Flanks slightly full and firm to moderately full and firm.	Moderately firm to firm.
Good	Moderately rangy and slightly angular, with slightly thin, tapering legs. Back slightly thin and narrow. Shoulders slightly thin and narrow. Neck moderately long and thin.	Red and narrow to slightly red and slightly side. Traces to slight amount of feathering between the ribs. Practically no overflow fat over the ribs adjacent to the backbone.	Red, moist, porous to slightly red, but rather dry and hard.	Inside flank muscle dark pink to slightly dark red in color. Practically no fat streaking to traces of fat streaking. Flanks slightly thin and soft to slightly full and firm.	Slightly firm to moderately firm.

8-6 PORK GRADING FACTORS



1/ An average of three measurements including the skin made opposite the first and last ribs and the last lumbar vertebra. It also reflects adjustment, as appropriate, to compensate for variations - from - normal fat distribution.

2/ Carcass weight is based on a hot packer style carcass.

3/ Carcass length is measured from the anterior point of the aitch bone to the anterior edge of the first rib.

8-7 DEFECTS AND THEIR CAUSES IN SAUSAGE

Defects	Causes
Coarse texture	Improper trim. Insufficient chopping. "Short meat" lacks binding quality.
Air pockets	No vacuum drawn. Improper filling of stuffer. Improper filling of casings. Improper air pressure. Improper size of stuffing horn.
Fading and shriveling	Improper chilling. Storing in cold draft. Storing in temperature that is too low.
Sweating and sliming	Fluctuating temperature. Storing warm product in low temperature.
Surface discoloration (greening)	Bacterial contamination after the heat process.
Internal discoloration	Bacterial contamination of raw materials before heat processing. Insufficient heat processing. Lack of nitrites

DAILY CALIBRATION AND OPERATIONAL CHECK TEST
FOR USE WITH HOBART FAT PERCENTAGE MEASURING KIT
(SIM SUBSECTION 225.8)

I. Sample units of ground meat will not be tested when frozen. All sample units should be about the same temperature when tested; not less than 34°F or more than 55°F.

II. When operating Hobart equipment in cold rooms or coolers below 65°F, preheat unit for two minutes prior to testing the first sample unit only. In addition, close unit to maintain heat.

III. Check accuracy of scale with the weight set balance prior to weighing the first sample unit and again at intervals of each six sample units weighed.

IV. The balance pan of the scale will be thoroughly cleaned with a damp cloth or absorbent paper prior to and after weighing each sample unit.

V. Time indicator is set for a time span of 15 minutes, plus or minus one minute. Periodically check time indicator with watch. When time indicator is two minutes or more inaccurate, replace the time indicator.

VI. The Power Line Monitor, RCA Model WV 120 A (AC) 100-140 volts, will be used to monitor the voltage during the entire period of use of the Hobart Kit. The unit is available through commercial retail outlets at a cost of approximately $19.00. It is also marketed nationally by Allied Radio, 100 N. Western Avenue, Chicago, Illinois 60608; Phone, (321) 421-6800. Allied Radio stock number is 2104193.

VII. Check the temperature of the heating element twice a week. Using a thermometer, self-indicating, bimetallic (comparable to FSN 6685-514-3757) a minimum temperature of 380°F should be attained. No tests will be performed at a voltage of less than 110 volts. Heating elements showing temperatures of less than 380°F should be subjected to additional tests prior to replacement. S satisfactory Hobart examination should be achieved, provided the voltage is not less than 110 volts; the heating element glows at a cherry red color; and the meat sample has a charred appearance at the end of the 15 minute test period.

VIII. Only test tubes manufactured by the Hobart Manufacturing Company will be used. The inside diameter of the test tube is calibrated along with the graduated scale to attain accurate fat percent.

IX. To determine fat percent, position the hair line pointers exactly in line with the bottom of the miniscus (concave) of yellow fluid. Read fat to the nearest whole percent.

Department of Veterinary Medicine
School of Health Care Sciences, USAF
Sheppard Air Force Base, Texas

HANDOUT 3ABR90830-VI-16
January 1975

INSPECTION OF MEAT PRODUCTS

PROBLEM #1

Inspection Record for Fabricated Beef

OBJECTIVE

A general knowledge of the preparation of the Product Verification Record (DD Form 1713) as it pertains to fabricated beef and identification and inspection of the cuts of fabricated beef.

REFERENCES

1-3

MIL-B-43813 as amended, MIL-STD-105.

SITUATION

1. YOU are assigned to Carswell AFB, Texas, with duty station at Fort Worth, Texas. You have procurement responsibility at the Estes Packing Company, P.O. Box 4511, Fort Worth, Texas 76106. This company has bid successfully on a contract for BEEF, BONELESS, FROZEN, Type III, Grill Steaks, Type V, Swiss Steaks and Type I Oven Roasts.

2. Your office and the Estes Packing Company have each received a copy of the purchase instrument (Purchase Order No. DSA 135-73-M-H042). This establishment will be working on an initial contract for the military under mandatory contractor inspection.

REQUIREMENTS

1. Complete a Product Verification Record (DD Form 1714) for all items in this contract (DSA 135-73-M-H042).

2. Use MIL-STD-105 for sample sizes and AQLs. The necessary inspection levels, defect numbers and defect classification are within MIL-B-43813.

3. Using the meat items distributed about the laboratory identify additional defects which may be added to those already found. (NOTE: This is an opportunity to familiarize yourself with fabricated meat cuts - use it.)

4. The information on the following pages should be transferred to your 1714's.

GRILL STEAKS - The following defects are noted in your examination of lot 201, consisting of 19,000 lbs/380 box, Type III, 7 oz., Grill Steaks.

TABLE OF EXAMINATION

III - Examination of packaging

2 - Bags not folded as specified
3 - Liners missing
4 - Layers thicker than thickness of 1 steak
3 - Separators missing

IV - Examination of steak net weight

65 steaks weighed 7 ounces
10 steaks weighed 6-1/2 ounces
3 steaks weighed 6-1/4 ounces
2 steaks weighed 8 ounces

DESIGNED FOR ATC COURSE USE
DO NOT USE ON THE JOB

VI - Examination of grill steaks for product characteristics

1 - Presence of foreign material
2 - Presence of unauthorized material
2 - Steak thickness less than 1/2 inch in any area
2 - Not cut at right angles
2 - Not cut as specified
1 - Periosteum exceeds 1 square inch of surface area
1 - Presence of bone

VIII - Examination of additional characteristics for formed steaks

6 steaks do not approximate specified shape
5 steaks fractured

IX - Examination of packing

2 - Strap missing
3 - Torn strap
4 - Loose strap
2 - Not packed as specified
2 - Tear or hole
8 boxes marked 55 Lbs
5 boxes marked 57 lbs

SWISS STEAKS - The following defects are noted in your preliminary examination of lot 209 consisting of 23,000 lbs/418 boxes of Type V, 6 oz., Swiss Steaks.

Table III

3 - bag not folded as specified
2 - separator not size specified

Table IV

4 steaks weighed 6 oz.
7 steaks weighed 8 oz.

Table VII

1 - presence of spotter tissue
1 - presence of dark cutter beef
3 - not cut at right angles to the grain of meat
4 - surface fat exceeds 1/2 inch in thickness
2 - excessive bruise
5 - semi-attached fat

Table VIII

8 steaks not approximate shape specified
3 steaks fractured

Table IX

1 - strap missing
2 - loose straps
3 - marking illegible
1 - tear in container
3 - marked net weight 58 lbs.

OVEN ROASTS - The following defects are noted in your examination of lot number 314 consisting of 15,545 lbs/300 boxes of Type I, Style 4, oven roasts, outside round. (Average wt. per roast - 5 lbs.)

TABLE OF EXAMINATION

III - Examination of packaging

2 - liner missing
4 - bag of insufficient length

V - Examination of roasts for product characteristics

1 - presence of spotter tissue
3 - presence of popliteal lymph gland
2 - presence of bone chip 3/4" long
2 - presence of bruises
4 - deep cuts
1 - protruding blood vessel

PROBLEM #2

COLEQUAP EXAMINATION
Bacon, Sliced, Chilled or Frozen

OBJECTIVE

A general knowledge of the procedures used in performing COLEQUAP audit, the preparation of the AF Form 2063, Individual COLEQUAP Report, and a familiarity of the defects common to sliced bacon.

REFERENCES

MIL-STD-105D, COLEQUAP Handbook, COLEQUAP Quarterly Program Notes, and Interim Federal Specification PP-B-0081G dated July 17, 1973.

SITUATION

1. The COLEQUAP requirements presented in this problem are typical of those you will encounter at base level, as is the product (sliced bacon).

2. The following situation exists at your base:

a. Type and amount of product available in commissary cold storage plant (received on base 18 September 1974).

(1) Bacon, Type II, Form B, Style 3, Class 3

(2) Amount: 18 shipping containers/432 pounds

b. Contract number DSA 133-74-8437 (Swineholt Packing Company, Big Pig, Pennsylvania, Establishment No. 1669).

c. Lot number 0147. DOP 17 July 1974.

d. Commissary warehouse hsa elected to issue 60 pounds to the base dining hall with the next scheduled use set up on a daily basis.

e. Received from Ft. Worth DPSC warehouse.

REQUIREMENTS

1. Utilizing the above information, <u>each</u> student will set up the appropriate sampling plan in accordance with:

a. X Quarter FY X Program Notes.

b. COLEQUAP Handbook

c. <u>ALL</u> applicable specifications, standards, referenced documents, and inspection forms.

2. Each individual student will accomplish the following:

a. Inspection of the "end item" in accordance with paragraphs 4.2.6., Table VIII, Examination of Packaging, Table IX, and Examination of Sliced Bacon, Table XI.

b. <u>NOTE</u>: On prior examination of eight (8) one (1) pound packages of sliced bacon, the following defects were found - (the 8 packages inspected and the defects found represent

a portion of the total sample size, record them on the AF Form 2063).

Table IX - One #204 and one #153.

Table XI - One #202 (slice length more than 10-1/2 inches); one #252 (break more than 1/2 the width of the slice); and one #253 (presence of comb hanger mark)